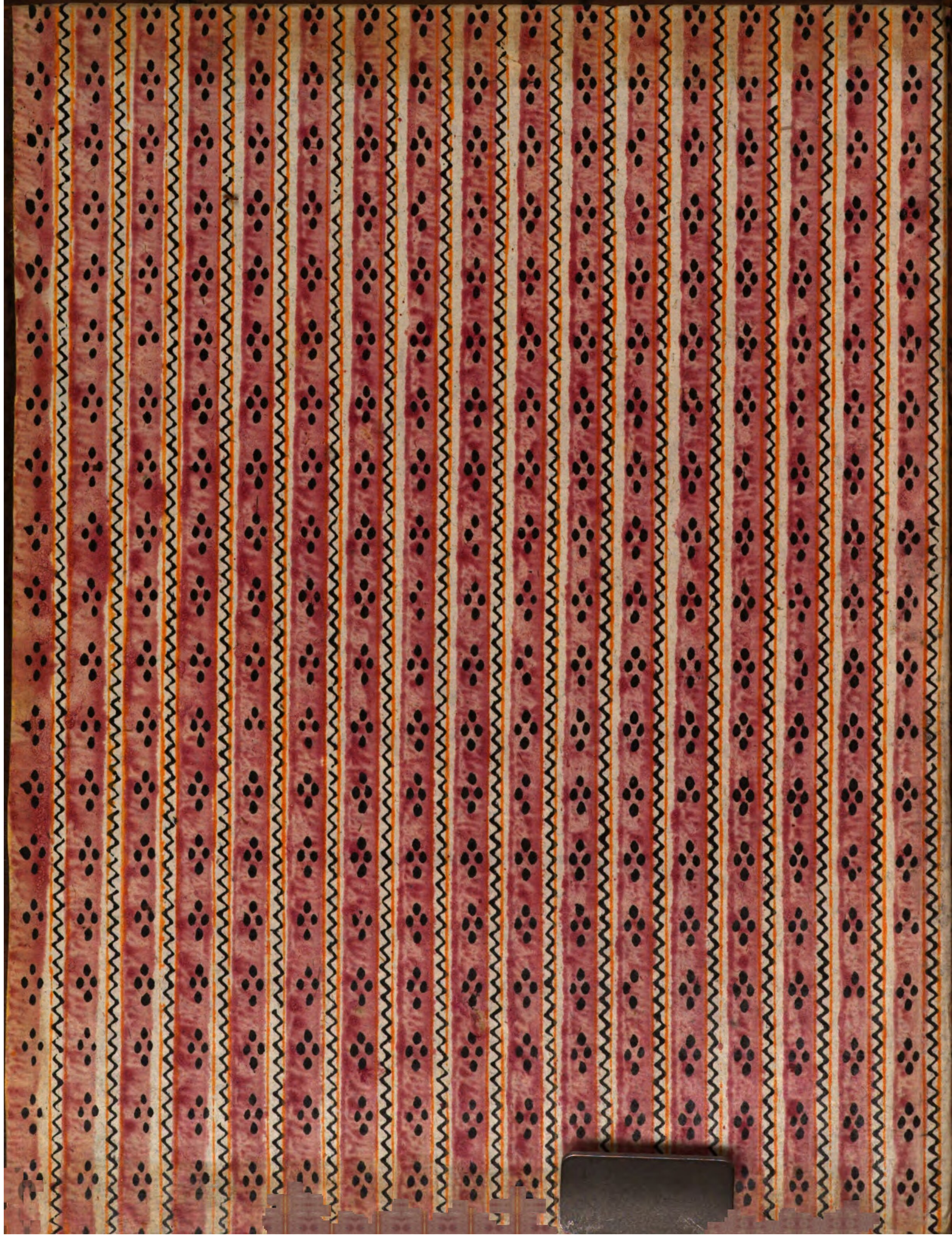








4^o

Um. 7629

angl. 89

A
GENERAL HISTORY
OF
INLAND NAVIGATION.

GENERAL HISTORY

OF

INLAND NAVIGATION

A
GENERAL HISTORY
OF
INLAND NAVIGATION,

FOREIGN AND DOMESTIC:

CONTAINING
A COMPLETE ACCOUNT OF THE CANALS ALREADY EXECUTED IN
ENGLAND, WITH CONSIDERATIONS ON THOSE PROJECTED.

TO WHICH ARE ADDED,
PRACTICAL OBSERVATIONS.

THE WHOLE ILLUSTRATED WITH A MAP OF ALL THE CANALS IN ENGLAND, AND OTHER
USEFUL PLATES.

By J. PHILLIPS.

LONDON:

PRINTED FOR I. AND J. TAYLOR,

AT THE ARCHITECTURAL LIBRARY, HIGH HOLBORN.

MDCCXCII.

GENERAL HISTORY
OF
INLAND NAVIGATION,

FOREIGN AND DOMESTIC
CONTAINING
A COMPLETE ACCOUNT OF THE CANALS ALREADY EXECUTED IN
ENGLAND, WITH CONSIDERATIONS ON THOSE PROJECTED.

PRACTICAL OBSERVATIONS.

THE WHOLE ILLUSTRATED WITH A MAP OF ALL THE CANALS IN ENGLAND, AND OTHER

BY J. PHILLIPS.

LONDON:

PRINTED FOR J. AND J. TAYLOR, AND J. TAYLOR, AND J. TAYLOR,

AT THE ARCHITECTURAL LIBRARY, HIGH HOLBORN.

MDCCCIII.

P R E F A C E.

THE utility of inland navigations is now so generally acknowledged, and so satisfactorily proved by the beneficial effects of those which have been already completed, that it seems scarcely necessary to say any thing on the subject. The canal begun by his Grace the Duke of Bridgwater, in 1759, has so evidently shewn the great advantages to be derived from such works, and given birth to so many similar projects, that since that time more than forty acts of parliament have been passed for making and perfecting canals, or for improving the inland navigation of this country; and several more petitions, for the same purpose, are now before parliament.

Inland navigation is highly beneficial to trade and commerce, by facilitating the communication between widely distant parts of the kingdom, reducing the price of carriage, and thus enabling the manufacturer to obtain his materials, fuel, and necessaries of life, at a lower rate, to convey his goods to market at a less expence, and consequently to sell cheaper than his competitors. In countries which have the advantage of canals, the old manufactures are rendered more flourishing, and new ones established, from day to day, in situations where the land before was of little value, and but thinly inhabited. They render the countries

through which they pass more rich and fertile ; since every meadow or pasture which they flow through displays a verdure never seen in the withered and adust spots that are at a distance from the banks of rivers and running waters. The merchants who reside at the ports where they terminate must also derive very considerable advantages from them, as they are enabled by them to export greater quantities of goods from places at a distance from the sea, and to supply with ease a greater extent of inland country with the commodities they import from foreign nations.

There are, perhaps, few objects of internal policy, that have so much called forth the powers and resources of the country, as canals. They have not only been the means of enlarging our foreign commerce, but of giving birth to an internal trade, which, with all the advantages attendant on foreign commerce, has perhaps far exceeded it in extent, value, and importance. So great has been the effect which these canals, and the trade to which they have given birth, have had on our industry, population, and resources, that in many instances they have entirely changed the appearance of the counties through which they pass.

The reasons of this change are sufficiently obvious. As consumers, by means of canals we are enabled to import more cheaply ; as producers, we export with greater facility. Do the materials of a manufacture lie dispersed ? Canals unite them, and at the same time supply the persons employed in it with every necessary at the cheapest rate ; and the land-owner, whether we
consider

consider the surface of the soil, or the mines in its bowels, necessarily finds his advantage from new markets, and from having a cheaper carriage both for his productions and his manure.

The experiment has now been made for some years, and canals have been cut to an extent of near a thousand miles, and in most cases to the advantage of the public, even where they have not been gainful to the individuals concerned in them. In some parts of the country prejudices still prevail; and the popular objection, that inland navigations tend to diminish the number of our seamen, has frequently influenced the minds of those who were not biassed by any particular private interest. In some instances the coasting navigation may have been lessened by them (though this has not been proved, and still remains doubtful), but in others it has been increased; and there can be no doubt that a greater extension of our distant navigation has arisen from a system which has, in effect, converted the internal parts of our island into coasts.

To the cheapness of conveyance, compared with land-carriage, should be added the advantages attendant on an easy and secure communication of the different parts of the country one with another, during the tempestuous months, and in times of war; when vessels from the northern parts of Europe will readily make the Humber, from whence, by means of canals, there is a communication with the rivers Mersey, Dee, Severn, Avon, Thames, &c. an extent of water-carriage exceeding five hundred miles, intersecting
the

the whole interior part of the kingdom ; and by which merchandise may be imported and exported with perfect safety from boisterous weather or obtruding enemies. The greatest advantages also may be expected to result from safe and speedy communications between the east and west parts of this island, by means of that grand undertaking the Forth and Clyde navigation. And if the proposed canals through the county of Hampshire should take place (which I hope I shall live to see), goods and stores of all kinds, from the magazines of London, Woolwich, &c. may then with certainty be conveyed to Portsmouth ; thereby avoiding a long, circuitous, and hazardous navigation. Similar advantages will attach to many other places, which I shall not now enumerate, as they must strike the eye, and convince the judgment of every one who inspects the map.

The bargemen and boatmen, though they have little experience in boisterous seas, are by no means unacquainted with the art of managing and loading vessels, and frequently find their way into our sea-ports, and thence on board our ships. But however little inland navigation may be supposed to form navigators for the sea, no lives are lost in the calm element on which they are employed ; the diseases of hot countries, so destructive to our seamen, are also unknown to them ; and there is no danger of their desertion, either in peace or war, to the service of foreign states, our rivals and enemies. In short, if the abundance of fresh-water rivers and lakes in a country has never been thought a detriment to its navigation, but the contrary, there

there seems no reason for supposing artificial inland navigations to be in this respect at all more injurious. When the history of inland navigations, and the spirit of industry and commerce come to be better understood, and popular prejudices decline, these objections to canal navigations will be no longer urged.

There are countries, in particular China and Holland, that have systematically encouraged canals and inland navigations at the public expence, neither of them wanting wealth, population, or employment. France has not been deficient in public undertakings of a similar nature. In England the zeal of individuals has had a public sanction ; but the undertakings have been conducted at their private expence. We build palaces for our public offices, and lavish immense sums in warlike preparations, more frequently actuated by caprice and passion, than guided by our true interests ; but we do not sufficiently cultivate those projects which would tend to cherish industry, to produce wealth, and increase real national strength. A time may come when the general system of all governments may be directed more to the encouragement of such public undertakings as may promote population and the prosperity of the country, than to the despicable intrigues and destructive ambition of courts.

A highway, a bridge, or a canal, may in most cases be made and maintained by a small toll upon carriages which make use of them ; a harbour by a moderate port-duty upon the tonnage of shipping which load and unload in it. When the carriages which pass

pass over a highway or a bridge, and the lighters and barges which are used upon a navigable canal, pay toll in proportion to their weight or their tonnage, they pay for the maintaining those public works in proportion to the wear and tear which they occasion. A more equitable way of maintaining such works cannot be found; for the tax or toll, though advanced by the carrier, is finally paid by the consumer, to whom it is charged in the price of his goods. Canals, roads, and bridges, consequently must be made where there is trade to support them. In several parts of Europe the toll, or lock-duties on a canal, is the property of some private person, whose interest obliges him to keep it in proper repair, if not the navigation ceases, and with it his profit; his principal, as well as interest, is therefore at stake. There is this difference between a high road and a canal; the road, if neglected, and suffered to fall to decay, is not entirely impassable; whereas a canal is. When a navigable canal has been once made, the management of it becomes quite simple and easy; and with respect to the making, it is reducible to strict rule and method: it may be contracted for with undertakers at so much per mile, and so much per lock: such undertakings therefore may be, and accordingly frequently are, very successfully managed by joint-stock companies.

Good roads, canals, and navigable rivers, by diminishing the expence of carriage, put the remote parts of the country more upon a level with those in the neighbourhood of large towns; they are, on that account, the greatest of all improvements. They encourage

encourage the cultivation of the remote parts, which must always be the most extensive circle of the country ; and thereby rents are much improved. They are advantageous to towns, by breaking up the monopoly of the country in their neighbourhood ; and they are advantageous to all parts of the country ; for, though they introduce some rival commodities, they open many new markets for their produce.

It is not more than sixty years ago that some of the counties in the neighbourhood of London petitioned parliament against the extension of the turnpike roads into the remoter counties ; because those remoter counties, it was pretended, from the cheapness of labour, would be able to sell their hay and corn cheaper in the London markets than themselves, and would thereby reduce their rents or ruin their cultivation. Their rents, however, have risen, and their cultivation has been improved since that time.

All canals may be considered as so many roads of a certain kind, on which one horse will draw as much as thirty horses do on the ordinary turnpike roads, or on which one man alone will transport as many goods as three men and eighteen horses usually do on common roads. The public would be great gainers, were they to lay out upon the making of every mile of a canal twenty times as much as they expend upon making a mile of turnpike road ; but a mile of canal may often be made at a less expence than the mile of turnpike, consequently there is a great inducement to multiply the number of canals.

Bad roads, and a difficulty of communication between places remote from each other, occasion a kind of sterility in a country, and render most things much dearer and scarcer than they would otherwise be ; and a nation placed in the most favourable climate, and blessed with the most fertile soil, if it have bad roads, and be without convenient modes of conveyance, will not be so rich and affluent as another nation less favoured in climate and soil, which shall have excellent roads and canals, supposing the genius and industry of both nations to be the same.

So fully to this point is the following paragraph by a gentleman (Major Rennell), to whom I am under other obligations, wherein also the great advantages arising from the easy communication by inland navigation, and the great disadvantages attending the want of such intercourse, are pointed out so clearly, and so much to my mind, that I am constrained to give it my readers. “ As both Europe, and its adjacent continent, Asia, are spread over with inland seas, lakes, or rivers of the most extended inland navigations, so as collectively to aid the transport of bulky articles of merchandise from one extreme of them to the other, and to form (like stepping-stones over a brook) a more commodious communication ; so likewise the northern part of the new continent appears to have an almost continuous inland navigation ; which must prove of infinite advantage to its inhabitants when fully peopled, and contribute to their speedier civilization in the mean time. But Africa stands alone in a geographical view. Penetrated by no inland seas, like the Mediterranean, Baltic, or Hudson’s Bay ; nor overspread with extensive lakes, like those of North America ;

America ; nor having, in common with the other continents, rivers running from the centre to the extremities ; but, on the contrary, its regions separated from each other by the least practicable of all boundaries, arid deserts of such extent as to threaten those who traverse them with the most horrible of all deaths, that arising from thirst ! Placed in such circumstances, can we be surprised either at our ignorance of its interior part, or of the tardy progress of civilization in it ? Possibly the difficulty of conveying merchandise to the coasts, under the above circumstances, may have given rise to the *traffic in men* ; a commodity that can transport itself."

When the Europeans first discovered America, the Peruvians, who were to a certain degree a civilized nation, had no other methods of transporting goods and heavy materials but on porters shoulders, or by the force of men's arms ; and it has been supposed that two thousand of them have been employed in removing one stone. A wide difference from modern times, when the improvements of mechanics in Europe will cause the same to be moved by five or six men, and with as little labour transported many miles on a canal. The cities, towns, and villages of Holland have such a free communication with each other by water, that they appear like the streets of the same city in respect to the convenience of carriage. There is a certain wood in Great Britain which has the advantage of a saw-mill, but being situated in the midst of mountains, where there are hardly any roads, it is the work of one horse to drag away four small deal boards ; and

if the distance on one side exceed twelve miles, they come dearer than if originally brought from Norway.

Bad roads tend not only to render things dearer, but also scarcer. Before the establishment of the post-office (which may be compared to an open road of the easiest communication), the carriage of a single letter was not only extremely dear, but very few were written. People might live happily were the number of letters diminished two-thirds; they could not, however, be said to live happily were the quantity of necessaries diminished two-thirds. The badness of roads lengthens the time of transportation of goods; for the same waggon that, upon an open and plain road, would be a weekly waggon, upon a rugged and difficult road becomes a monthly one; and the carrier is obliged to quadruple his charge on the conveyance; and a nation in a fertile soil, and with numerous inhabitants, is far from being that happy and accommodated people which might be expected.

Were we to make the supposition of two states, the one having all its cities, towns, and villages upon navigable rivers and canals that have an easy communication with each other; the other possessing only the common conveyance of land-carriage: supposing, at the same time, both states to be equal as to soil, climate, and industry, commodities and manufactures in the former state might be expected thirty per cent. cheaper than in the latter; or, in other words, the first state would be a third richer and more affluent than the second. This, perhaps, is one of the chief causes of
the

the great wealth of China, which, historians tell us, is wholly intersected with navigable rivers and canals: but Great Britain and Ireland might soon rival China in this last particular, and consequently their people in general might be more rich and affluent.

There is yet one objection to navigable canals (a poor one indeed), viz. that they waste or take up too great a portion of land in the counties through which they pass: but I hope it will be a full and cogent answer to this objection, that ONE MILE of the duke of Bridgewater's navigation takes up only ONE ACRE AND A HALF of land.

To conclude: the object of the following sheets is to present the reader with a complete, yet concise, History of Canals, both ancient and modern; but more especially of those completed or projected in England. Of the latter, a large and correct map is given; in which the canals that are completed are coloured *red*; those projected, *brown*; and the rivers, as far as they are navigable, *blue*.

Four other plates are also added, which, it is presumed, will be found useful by such as may be engaged in executing undertakings of this kind. These consist of plans, elevations, and sections for a lock, aqueduct, and bridges.

The author has spared no pains in the collection of his materials: he has endeavoured to avail himself of every publication
relative

relative to his subject, from which he has selected the information that appeared to him of most importance, and which he has been enabled to correct and enlarge, in consequence of his having been employed in various works of this kind in different parts of the kingdom, and in foreign countries. He is not however so vain as to suppose that he may not have committed some mistakes, notwithstanding all his attention and care ; but the liberal enquirer will remember, that, as this species of improvement is as yet only in its infancy, the information necessary on the subject is more difficult to collect, and errors less easily avoided : he can only say, that he has spared no labour or attention to detect and rectify them. He has not been solicitous to attain to elegance, but he has earnestly endeavoured to be accurate and perspicuous : to this praise alone he aspires, and with a modest, but, he trusts, a well-founded confidence, submits his performance to the judgment of an impartial, but candid public.

C O N T E N T S.

C H A P. I.

UTILITY of inland navigation—Ancient canals—Canals of Egypt—Account of the great canal cut through the isthmus of Suez, from Diodorus, Herodotus, and Strabo—Description of the nilometer, or instrument for measuring the inundation of the Nile.

Page 1

C H A P. II.

Canals of China, prodigious trade carried on by them from the remotest part of the empire—Account of the royal canal, its length and trade—No private property or plantation, even of the emperor, allowed to obstruct the cutting of a canal—The emperor, or governor of a province in which a new canal is made, digs the first spade of earth—No locks on the Chinese canals—The strange method employed by the Chinese to raise or fall vessels out of one canal into another, where they are not level—Prodigious numbers of vessels employed on these canals for the emperor only—Carefulness of the Chinese to husband every spring of water—Account of canals in Hindostan.

Page 8

C H A P. III.

Canals of Russia—The first begun by colonel Breckell, a German, who failed in the attempt, and fled the country—Captain Perry employed by the czar, Peter the Great—Three different surveys of captain Perry—Account of the celebrated canal and locks of Vishnei-Voloshok—Navigation up the Twertza to Vishnei-Voloshok—Navigation from the Caspian sea to the Baltic—Prodigious number of vessels employed in this inland navigation—Course of the inland navigation from Kiatka, the frontier town of Russia next to China, to Moscow and Petersburg—Great extent of this navigation—Trade carried on by it between China and Russia.

Page 20

C H A P. IV.

Canals of Sweden and Denmark—Canal of Trolhaetta in Sweden—Numerous obstructions and impediments to its completion—Prodigious sums of money and immense labour that it has cost—Polhem employed on it by Charles XII.—His plan, after an incredible expence, and the labour of several years, proves abortive—Junction of the lake Aielmar with the Maeler by a canal—Junction of the Maeler with the Wenner—Canal of Carlsgraff—Difficulty of passing the cataracts of Trolhaetta—Sluices constructed

structed by Polhem described—Account of the canal of Kiel, in the duchy of Holstein—Length, breadth, and fall of this canal—Its utility, by effecting a junction between the Baltic and the German ocean. - - - Page 35

C H A P. V.

Canals of Holland—Extensive trade carried on by them—Canals of Flanders—Their ruinous condition at present. - - - Page 47

C H A P. VI.

Canals of France—Canal cut by Lucius Verus—Canal of Briere—Canal of Orleans—Canal of Bourbon—Junction of the Somme with the Oise—Particular Description of the celebrated canal of Languedoc—Trade carried on by that canal—Other canals in France—Canals proposed to be cut in that country—Description of the magnificent aqueduct of Maintenon, built by Louis XIV.—Canals of Spain—Canal of Arragon—Canal of Castile—Canal of Murcia—New canal from the Escorial—Canal begun, but not completed—The interior parts of Spain capable of great improvement by canals. - - - Page 51

C H A P. VII.

Of the canals of England.—Canal of Caerdyke—The New River—The duke of Bridgewater's canal, being the first navigable canal made in England—Difficulties surmounted in the execution of this astonishing work—Account of the aqueduct by which the canal is carried over the river Irwell, near Barton-bridge—Extracts of the acts, enabling the duke to cut his canal—Utility of this canal—Particulars of the life of the ingenious Mr. Brindley, the engineer employed by his Grace in this great work—Description of the subterraneous passage into, and the inside of his Grace's coal mine at Worsley mill—Account of the surveys for an intended inland navigation from Liverpool to Hull. - - - Page 70

C H A P. VIII.

Particulars of two plans for a communication by canals between Liverpool, Bristol, and Hull—Course of the intended canals to join the river Weaver in Cheshire to the Trent in Staffordshire—Expence of cutting, and length of these canals—Number of, and expence of constructing, the locks necessary to complete them—Advantages of them to the counties through which they would pass, and to the nation at large. - - - Page 105

C H A P. IX.

Plan of the canal proposed by Mr. Brindley—Advantages to be expected from it—Manufactures, commerce, and produce of the interior parts of the country through which it is to pass—Its length, breadth, and depth—Different falls of the two canals—Estimate of
of

of the expence of completing it.—Comparative view of the expence of land-carriage and carriage by inland navigation.—Comparative statement of the quantity of land lost by cutting the canal, and that necessary to grow horse corn only.—Facts and reasons proving Mr. Brindley's plan to be preferable to that of which an account is given in the preceding chapter.—Objections made against it. - - - Page 155

C H A P. X.

Coventry and Oxford canals, from the grand trunk of the Trent and Mersey canal at Fradley Heath, into the river Thames at Oxford.—Extent and course of the canal through the counties of Stafford, Warwick, and Oxford.—Its width, depth, rise, and falls of water.—Extracts from the different acts passed for making this canal.—Its general utility to trade, manufactures, and commerce.—Birmingham and Fazeley canal, which joins the former canal.—Extract of the acts of parliament for consolidating the proprietors into one company.—Aqueduct at Fazeley.—Collateral cuts from Birmingham to Digbeth, and the coal mines.—Canal cut from near Newcastle-under-Line to Froghall, and Caldenloe coal-mines and lime-stone quarries.—Stroudwater canal to the Severn.—Droitwich canal.—Account of the Thames and Severn navigation, and the junction of those rivers by means of a canal from Leachlade to Stroud.—Short extract from the acts obtained for making this junction.—A canal to join the Thames and Severn projected in the reign of Charles II.—Extensive trade carried on by this and the Coventry and Oxford canals. - - - Page 201—229

C H A P. XI.

Account of a proposal for opening a canal navigation from the river Thames to the Severn.—Project to shorten the Thames navigation, by a cut or canal from Monkey Island, near Maidenhead, to Reading.—The scheme at present rendered abortive.—Account of the intended canal from Reading to Isleworth.—Its utility.—Section of the river from Mortlake to Boulter's lock.—Account of the canal projected from London to Waltham Abbey, into the river Lea.—Canal from Limehouse into the river Lea.—Leeds and Selby canal.—Account of the Huddersfield canal.—Leeds and Liverpool canal.—Kendal canal to Liverpool.—Plan for an inland navigation from Kendal to London, above five hundred miles in length, and other navigations which might be carried into execution to great advantage.—Basingstoke canal.—Andover canal to Redbridge, near Southampton.—Winston canal, in the bishopric of Durham, by Darlington, to Stockton, on the river Tees.—Chester canal to Middlewich, with the branch to Nantwich.—Birmingham Canals.—Langley bridge canal.—Chesterfield canal.—Proposed canal from Bude to Launceston in Cornwall.—Canal from Market Weighton to the Humber, and for draining twenty thousand acres of land.—Canal cut by Sir Nigel Gresley, to supply the town of Newcastle-under-Line with coals, from his estate at Apefdale, in the county of Stafford.—Canal cut by the earl of Thanet, from his estate called the Spring, near Skipton Castle, in the county of York, to join the na-

vigable canal from Leeds to Liverpool, to supply the neighbourhood with lime and lime-stone.—Account of the canal cutting from Cardiff, in the county of Glamorgan, in South Wales, to a place called Merthyr Tidwell, in the same county.—Projected canal from Neath, in the same county, to Furno Vaughan.—Account of two canals already cut through private property for the public good; one of them from near Swansea to Neath, through a morass; the other from Kidwelly in Carmarthenshire, to the coal-mines of Mr. Keymer. - - - Page 230—275

C H A P. XII.

Account of the canal from the Forth to the Clyde, in Scotland.—Such a canal proposed in the reign of Charles II.—Begun under the direction of Mr. Smeaton in 1768.—Collateral canal cut from the grand canal to Glasgow.—The grand canal completed in 1790, under Mr. Robert Whitworth.—Extracts from a pamphlet on the navigation between the rivers Forth and Clyde.—Account of the length, rises, falls, locks, tonnage, &c. on the grand canal.—Account of an intended canal between Loch Gilp and Loch Crinian. Account of an intended canal between Inverness and Fort William. Page 276—329

C H A P. XIII.

Account of the canal from Dublin to the Shannon, in Ireland.—Various reports of different engineers on the difficulty of cutting this canal, which is not yet completed, notwithstanding the immense sums it has cost.—Resolves of the canal company with respect to the carrying on the work, and finding materials.—Account of the Newry canal.—Extracts from A. Young's Tour through Ireland. - - Page 330—359

C H A P. XIV.

Some practical observations relative to the places proper for canals—the supply of water—the most eligible levels—the nature of the ground to be cut through—and the expence and mode of execution.—Description of a lock, a tunnel, and an aqueduct. Page 359

ALPHABETICAL LIST of CANALS,

Of which an Account is given in this Work.

A.		F.		Page
ANCIENT canals		Flanders, canals of	-	48
Andover canal	-	Forth and Clyde canal	-	276
America, North, canals of	-	France, canals of	-	51
— South, canals of	-			
		G.		
		Gresley's (Sir Nigel) canal	-	271
B.				
Basingstoke canal	-	H.		
Birmingham canal	-	Hereford canal	-	367
— and Fazeley canal	-	Hindustan, canals of	-	15
— canal to the Severn at Diglis	-	Holland, canals of	-	47
Bridgewater's (Duke of) canal	-	Huddersfield canal	-	244
Bude canal	-			
		I.		
C.		Ireland, canals of	-	330
Caerdyke canal	-			
Cardiff canal	-	K.		
Chester canal	-	Kendal to Liverpool canal	-	255
Chesterfield canal	-	Kidwelly canal	-	271
China, canals of	-	Kington canal	-	367
Coventry canal	-			
		L.		
D.		Langley-bridge canal	-	265
Denmark, canals of	-	Leeds to Selby canal	-	242
Droitwich canal	-	— and Liverpool canal	-	245
Dudley canal	-	Leicester canal	-	368
		Liverpool to Hull and Bristol canal	-	102
E.		— and Leeds canal	-	245
Egypt, canals of	-	— and Kendal canal	-	255
England, canals of	-			Manchester

M.		S.	
	Page		Page
Manchester canal	369	Scotland, canals of	276
Market Weighton canal	269	Severn and Thames canal	219
Melton Mowbray canal	368	Spain, canals of	64
		Stroud canal	211
		Swansey canal	275
		Sweden, canals of	35
N.		T.	
New River (the)	72	Thanet's (Earl of) canal	273
		Trent and Mersey canal	155
O.		W.	
Oxford canal	201	Wales, canals of	274
		Waltham Abbey, projected canal from London to	238
R.		Winston canal	261
Reading to Monkey Island intended canal	231	Wolverhampton canal	175
to Isleworth	234		
Ruffia, canals of	20		

HISTORY OF INLAND NAVIGATION.

CHAP. I.

Utility of Inland Navigation—Ancient Canals—Canals of Egypt—Account of the great Canal cut through the Isthmus of Suez, from Diodorus, Herodotus, and Strabo—Description of the Nilometer, or Instrument for measuring the Inundation of the Nile.

THAT the greatest advantages are derived to mankind from navigation, which establishes an intercourse between all the different inhabitants of the earth, and enables them to supply their mutual wants, by exchanging their various productions, is a position which no one will dispute. To the improvements made in that most useful art, are the commercial nations of Europe principally indebted for their superiority over the rest of the world in power and opulence, the consequence of their extensive trade, and the flourishing state of their manufactures.

But what the ocean is to the distant countries it divides, navigable rivers and canals are to the different provinces and districts of the same country; and as navigation on the former effects an intercourse, and mutual exchange of productions, between different kingdoms; in like

manner inland navigation facilitates a communication between, and consequently promotes trade and industry in, the different parts of the same kingdom. It seems indeed totally unnecessary at present to attempt to enumerate the great benefits which accrue to trade and commerce from inland navigation. There is scarcely any civilized people, either ancient or modern, but have borne testimony to the utility of canals, by executing works of that kind.

Among the nations of antiquity, Greece, the mistress of the world in arts and science, did not want canals; that country being every where bounded and indented by the Ægean and Ionian seas, with their numerous bays, havens, creeks, and rivers: yet history informs us of many projects and undertakings of canals which were never completed. Demetrius Poliorcetes, Julius Cæsar, and the emperors Caligula and Nero, attempted in vain to cut through the isthmus by which Peloponnesus is joined to the rest of Greece, and thus form a communication between the Ionian and Ægean seas. We also find traces of canals cut to drain off the waters of the lake Copais in Bœotia, of such remote antiquity that all knowledge of the time when they were made has now been lost for many ages. The following is the account given of them by the ingenious and learned Abbé Barthelemy, in his Travels of Anacharsis the Younger.

“ Bœotia may be considered as a large basin surrounded by mountains, the different chains of which are connected by high grounds. Other hills stretch into the heart of the country: most of the rivers which proceed from them unite in lake Copais, which is three hundred and eighty stadia (about forty-three English miles) in circumference, and which neither has nor can have any apparent issue; it would, therefore, soon overflow Bœotia, had not the industry of man contrived secret passages to drain off the water. In the part adjoining to the sea, the lake terminates in three bays, which advance to the foot of mount Ptous, situated between the sea and the lake. From the bottom of each of these bays

diverge

diverge a number of canals, that traverse the mountain through its whole breadth, some of which are thirty stadia (or more than three miles) in length, and others a much greater extent. To excavate or cleanse them, very deep wells had been sunk, at stated distances, on the mountain.

“The traveller, when he views these works, is astonished at the difficulty of the enterprise, as well as at the expence it must have cost, and the time requisite for its completion. But what is still more surprising is, that these canals and pits, of which neither history nor tradition has preserved any remembrance, must be attributed to the most remote antiquity, and that in those distant ages we have no knowledge of any power in Bœotia capable of forming and executing so vast a project.”

Rome, more attentive to enslave the world by conquest, than to extend her commerce or improve the arts, affords us no examples of canals for internal navigation; but her magnificent aqueducts, though not strictly within the plan of the present work, deserve to be mentioned. These were constructed, at an immense expence, for the conveyance of water to that rich and populous city. Some of them were of stone, others of brick, and others of wood; some conveyed the water underground, and others above it, supported by arches of prodigious solidity, beauty, and grandeur; and of the latter some are recorded to have extended a hundred miles in length. Frontinus, a man of consular dignity, who had the direction of the aqueducts, under the emperor Nerva, tells us of nine that emptied themselves through thirteen thousand five hundred and ninety-four pipes of one inch diameter; and Vigenere observes that Rome received from these aqueducts no less than five hundred thousand hogheads of water in twenty-four hours.

In the year 1789 the canal which was cut by the emperor Claudius to drain the Fucine lake into the river Liris, was begun to be cleansed, to the great relief of the neighbouring country, which was inundated by its obstruction.

Egypt, depending entirely on the overflowing of the river Nile for the watering of the country, contained a great number of canals, dug to receive and distribute the waters of the river, at the time of the inundation: but the principal work of this kind, in that country, was the grand canal by which a communication was made between the Nile and the Red Sea. This was begun, according to Herodotus, by Necos, the son of Psammetichus, who desisted from the attempt on an answer from the oracle, after having lost one hundred and twenty thousand men in the enterprize.

Diodorus Siculus gives the following account of this canal.

“ A canal of communication has been cut, which passes from the Gulph of Pelusium into the Red Sea. It was begun by Necos, son of Psammetichus, and continued by Darius, king of Persia; but at length laid aside by the advice of some persons, who asserted it would lay Egypt under water, because the land was below the level of the Red Sea. Ptolemy the Second, however, finished the undertaking; but constructed, in the most convenient part of the canal, a dam, or sluice, ingeniously contrived, which opened to give passage, and immediately closed again: on that account the river, which discharges itself into the sea, near the city of Arsinoe, has received the name of Ptolemy's River.”

This canal was wide enough for two galleys to pass abreast, and four days sailing in length; and was far superior, for utility, dimensions, and trade, to any other canal in the then known world. The wealth of India, Persia, Arabia, and the kingdoms on the coast of Africa, was brought by shipping to the Red Sea, and, by this vast canal, conveyed to the Nile, whence it was distributed by the Mediterranean, not only to Greece and Rome, but to all the surrounding nations, until the Portuguese discovered a way to India by the Cape of Good Hope.

This canal after the time of Ptolemy fell into disuse, and policy had
probably

probably some share in the neglect of it; but it was again opened in the year 635, under the Caliph Omar. Elmacin, indeed, says that a new canal was then made for the conveyance of the corn of Egypt to Arabia: but this is more naturally to be understood of the renewal of the ancient one, the navigation of which, towards the decline of the Roman empire, had been much neglected. The same author adds, that it was stopped again at the end next the Red Sea, by the Caliph Abugiafor Almanzor, the second of the family of Abbas, in the year of the Hegira 150, answering to the year of Christ 775. There are some traces of it still subsisting. M. Boutier in 1707 discovered the end which rises out of the most easterly branch of the Nile.

Abulfeda thus describes the beauty of the canal of Faoua: "No prospect can be more enchanting or agreeable. Gardens, groves, and eternal verdure adorn its banks, which are shaded by date trees, covered with vines, and embellished with pleasure houses." The above canal was cut from the Nile to Alexandria by Ptolemy, to fill the immense cisterns, which are vaulted with great art, and constructed in all parts of that city. The numerous magnificent aqueducts are still almost entire, although they are above two thousand years old: but they are now useless, as they have been for many ages.

Strabo tells us that the canal between Alexandria and Canopus, in which city was a temple of Serapis, was loaded night and day with boats, which carried religious votaries to the deity: this canal is now dry. Herodotus also says that the stones for the building of the temple of Latona in Egypt, were brought by rafts, down the canals of the river Nile, a distance of two hundred leagues. He measured one single stone, which was sixty feet square, and six feet thick: it was intended for a pedestal for a column, fifty feet high, six feet diameter, and also cut out of a single block of stone.

The annual inundation of the Nile is the source of the fertility of Egypt.

Egypt. When the water has risen to a certain height, the Khalig, or grand canal, is opened, by which it is conveyed, by a prodigious number of smaller canals, into reservoirs and cisterns, to be distributed among the fields and gardens as it is wanted. To determine when it has attained to this height, a pillar, called a Nilometer, is erected in an island opposite Cairo, and divided into picks, a measure of about two feet. The following is the account given of it by Baron de Tott.

“The progress of the inundation is observed at the Nilometer, situated at the southern point of the island of Rhoda, opposite Old Cairo. Public criers, distributed in each quarter of the capital, every day make known to the people the rising of the waters, till they are come to the height proper for opening the canal, by which they are conveyed to the middle of the city, and the cisterns. But this moment cannot be ascertained with precision, because superstition prevents the eye of curiosity from approaching the graduated column. Placed in the centre of the basin of the Nilometer, the cry of *Oof-Allah*, which signifies, God has kept his promise, proclaims the opening of this canal. Children bearing streamers of different colours accompany the crier, and diffuse a general joy at the certainty of plenty.

“Sultan Selim, after having conquered Egypt, gave it laws, established a new form of government, and decreed that this kingdom, now become a province of his vast empire, should be only liable to a tribute, when the increase of the Nile should be sufficient for opening the canal; as, in fact, it is only then that the waters suffice for the wants of agriculture. This is what takes place every year. But it is not merely this degree of increase that yields the greatest plenty: to produce that the waters must reach the foot of the mountains; and then it is that the criers proclaim, *Minel-Dgebel il- Dgebel*, “from one mountain to another.”

“The ancient Egyptians had the barbarous custom of sacrificing a young

young girl to the Nile, when the waters rose to a sufficient height for opening this canal. They call her the *Arooffa* or the Bride; and the name and ceremonies of this sanguinary festival are still preserved, though the Caliph Omar has rendered it more humane by substituting a pillar of earth, which represents the victim, and is thrown into the Nile. The principal inhabitants of Cairo appear at this ceremony in their gondolas, richly ornamented; and it is always succeeded by entertainments and fireworks. A great number of other canals, only taken care of by those who derive advantage from them, issue from that arm of the Nile which runs to Damietta, and fertilize the province of Sharkia, which, making part of the Isthmus of Suez, is the most considerable of Egypt, and the most capable of a great increase of cultivation. The plains of Gaza, which lie beyond and are possessed by the Arabs, would not be less fertile, if the spirit of devastation did not destroy even the spontaneous productions. A number of other canals run through the island of Delta, many of which are navigable; and that of Manoof, or Meneuf, communicates with the two branches of the Nile, ten leagues below the angular point called *the Belly of the Cow*. This canal begins at Nadir, and not at Gueseid, where D'Anville has placed the mouth of it, and crosses the province of Manufia, the culture of which may be compared to a well-managed kitchen garden."

"The vestiges of the canals which watered the provinces westward and eastward of the Delta, prove them to have been the best cultivated of any part of ancient Egypt: we may also presume, from the extent of the ruins of Alexandria, the construction of the canal, and the natural level of the lands which encompass the lake Mareotis, and extend themselves westward to the kingdom of Barca, that this country, at present given up to the Arabs, and almost a desert, was once sufficiently rich in productions of every kind to furnish the city of Alexandria with its whole subsistence."

C H A P. II.

Canals of China, prodigious Trade carried on by them from the remotest Part of the Empire—Account of the Royal Canal, its Length and Trade—No private Property or Plantation, even of the Emperor, allowed to obstruct the cutting of a Canal—The Emperor, or Governor of a Province in which a new Canal is made, digs the first Spade of Earth—No Locks on the Chinese Canals—The strange Method employed by the Chinese to raise or fall Vessels out of one Canal into another, where they are not level—Prodigious Numbers of Vessels employed on these Canals for the Emperor only—Carefulness of the Chinese to husband every Spring of Water—Account of Canals in Hindoostan.

C H I N A.

IN the great empire of China there is scarcely a town, or even a village, which has not the advantage either of an arm of the sea, a navigable river, or a canal, by which means navigation is rendered so common, that there are almost as many people live on the water as the land.

The Great Canal, which is also called the Royal Canal, is one of the wonders of art: it was finished about the year 980; thirty thousand men of all denominations were employed forty-three years in completing it. It runs from north to south, extending from the city of Canton to the extremity of the empire; and by it all kinds of foreign merchandize, entered at that city, are conveyed directly to Peking, being a distance of 825 miles. Its breadth is about fifty feet, and its depth a fathom and a half,

half, which are sufficient to carry barks of considerable burthen, which are managed by mast and sails, as well as by oars; and some of a smaller sort are towed by hand. The emperor of China is said to employ ten thousand ships, abating one, for a reason very peculiar. This canal passes through, or near, forty-one large cities; it has seventy-five vast sluices to keep up the water, and pass the barks and ships where the ground will not admit of sufficient depth of channel, besides several thousands of draw and other bridges. Innumerable canals are cut from this main canal, and the whole empire abounds with rivers, lakes, and rivulets.

China owes the greatest part of its riches and fertility to these numerous canals, which are of the greatest utility for the transportation of the produce and merchandize of one province to another: they are bordered, or faced, with quays of freestone, and in low marshy places very long causeways are raised for the convenience of travellers. These canals are cut through any kind of private property, gardens, plantations, or pleasure-grounds; not even the gardens of the emperor, or any of his governors, are exempted: but when the work arrives at the garden or pleasure-ground, the governor, or even the emperor himself, digs the first spade of earth, and pronounces with an audible voice, "This is to let those of inferior situations know, that no private pleasure shall obstruct the public good." There are bridges over these canals, of three, five, seven, or more arches, to open a free communication with the country: the middle arch is generally very high, that barks and barges may pass under it with their masts standing. When the water is high, and liable to overflow the neighbouring fields, they take care to open the sluices to convey it away, and to keep it at a certain height in the canal. There are inspectors appointed to survey the canal and visit it continually, and workmen always ready to repair the damaged places.

And here permit me to mention one circumstance, in which it would not be beneath the magistrates of this country to imitate the example of the

Chinese. In the whole of this great empire of China it is an established maxim, that when a crime of magnitude is committed, the mandarin of the province shall be punished, because the law commands him to take care of the morals of the people. As God has given to every country the means of subsistence, it is a high offence to magistracy that men should commit crimes through distress.

The criminals are obliged to work on the canals for a time, according to their several offences: they wear a disgraceful dress, and are allowed only a bare support of very ordinary provisions.

F. Magaillane assures us that there is a passage by inland navigation from one end of the empire of China to the other, being a space of 600 French leagues, and that a traveller may go this whole distance entirely by canals or rivers, except a single day's journey by land, to cross a mountain; an advantage which this jesuit, who made the voyage himself, observes, is not to be found in any other kingdom or state in the universe.

The Abbé Grosier observes, that it is recorded in the annals of China, that their emperors gave every encouragement to agriculture, and thought it far superior to gold, silver, or precious stones. One particular deserves notice. About the year 1500 a merchant had opened a mine of precious stones. As soon as it was known, the emperor caused it to be shut, with this observation: "Useless labour causes sterility: a mine of precious stones does not produce corn."

For several of the preceding observations on the canals of China I am indebted to Du Halde: the following are extracted from the Journey of Louis le Comte, the Jesuit, who was above ten years a missionary, and travelled through the whole empire of China.

"Although China were not of itself," says he, "so fruitful a country as I have represented it, the canals which are cut through it would be

be alone sufficient to render it so : but besides their great usefulness in watering the country, and promoting trade, they also add greatly to its beauty. They generally contain a clear, deep, and running water, that glides so softly that it can scarcely be perceived. There is commonly one in every province, which is to it instead of a road, and runs between two banks, built up with flat coarse marble stones bound together by others which are jointed into them.

“ One large canal generally runs through every province, and a vast number of smaller ones are cut from that large one, which again are subdivided into still smaller, or rather rivulets, that end at some village or great town : sometimes they discharge themselves into a lake or large pond, from which all the adjacent country is watered ; so that these clear and plentiful streams, embellished by a great number of fine bridges, bounded by neat and convenient banks, equally distributed through vast plains, covered with a numberless multitude of boats and barges, and crowned (if I may use the expression) with a prodigious number of towns and cities, whose ditches they fill, and whose streets they form, at once render that country the most fruitful and most beautiful in the world.

“ Surprised, and as it were astonished, at so noble a sight, I have sometimes borne a secret envy to China in Europe’s behalf, which must own that it can boast nothing in that kind to be compared to the works of the Chinese. What would it be then, if that art which in the wildest and most unlikely places has raised magnificent palaces, gardens and groves, had been employed in that rich land to which nature has been lavish of her most precious gifts !

“ The Chinese say their country formerly was totally overflowed, and that by dint of labour they drained the water by cutting it a passage through these useful canals. If this be true, I cannot enough admire at once the boldness and industry of their workmen, who have thus made

great artificial rivers, and from a kind of sea created the most fertile plains in the world.

“It will scarcely be believed that men so ignorant in the principles of physics, and the art of levelling, could bring such works as these to perfection; yet it is certain that these canals were dug by men, for they are usually straight, and their distribution is equal and orderly. There are flood-gates made for the rivers to let in their water, and others to let it out when they are too full; so that it cannot be doubted but that the Chinese are only indebted to their own industry for that great conveniency.

“Among all those canals in the southern provinces, one above the rest is called the Great Canal, because it traverses the whole country from Canton, which lies on the southern side, to Peking, situated in the most northerly part of the empire. We need only travel a short day's journey by land to cross the mountain, called Moilin, which on one side bounds the province of Kiamfi. Two rivers rise in this mountain, one of which runs southwards to the sea, and the other northwards as far as the river of Nankim, whence by the yellow river and several canals we may proceed by water to the very mountains of Tartary.

“But since, in this vast extent of ground of above four hundred leagues in length, the earth is not level, or hath not a descent proportionable to the emanation of the waters, it was necessary to construct a great number of sluices. They are called by the name of sluices in the relations of travellers, notwithstanding they are very different from ours; they are rather water-falls, and as it were torrents that are precipitated from one canal into another, and more or less rapid, according to the difference of their level. To cause barks or barges to ascend, they make use of a great company of men, who are maintained for that purpose near the sluice: after they have drawn cables and ropes to the right and left, to lay hold of the bark in such a manner that it cannot escape

escape them, and every cable and rope is made tight, they have several capstans, by the help of which they raise it by little and little by exerting the utmost strength of their arms, and employing levers, till they have raised it into the upper canal, in which it may continue its voyage. This labour is tedious, toilsome, and exceedingly dangerous. They would be wonderfully surprised could they behold with what ease and facility one man alone, who opens and shuts the gates of our locks and sluices in Europe, makes the longest and heaviest laden barks and barges securely to ascend and descend.

"I have observed in some places in China, where the waters of two canals have no communication together; yet for all that they make the boats to pass from one to the other, notwithstanding the level may be different above fifteen feet: to effect which they proceed in this manner: at the end of the canal they have built a double glacis, or sloping bank of freestone, which uniting at the point extends itself on both sides up to the surface of the water. When the bark is in the lower canal, they hoist it up, by the help of capstans, to the plane of the first glacis, so far, till being raised to the point, it falls back again by its own weight along the second glacis (I suppose, instead of falling back again, that it falls forwards) into the water of the upper canal, where it skuds away to a considerable distance, like an arrow out of a bow; and they make it descend after the same manner proportionably. I cannot imagine how these barks, being commonly very long and heavy laden, escape being split in the middle, or having their backs broken, when they are poised in the air upon this acute angle; for, considering the length, the lever must certainly have a strange effect upon it: yet do I not hear that any accidents happen in consequence of it. I have passed that way several times; and all the precaution they take when they do not choose to go on shore during the operation, is to tie themselves fast to some cable, or rope, for fear of being tossed from prow to poop (it should be from stern to stem, or from poop to prow).

"We

“ We meet with no such sluices in the Grand Canal, because the emperor's barks, that are as large as our frigates, could not be raised by force of arm, nay would infallibly be split in the fall. All the difficulty consists in surmounting these torrents of which I have spoken: yet this is what they perform successfully, though not without some trouble and expence.

“ These water passages, as they call them, are necessary for the transportation of grain and stuffs, which they fetch from the southern provinces, and carry to Pekin. There are, if we may give credit to the Chinese, a thousand barks, from eighty to an hundred tons, that make a voyage once a year, all of them freighted for the emperor, without reckoning those of particular persons, which are innumerable. When these prodigious fleets set out, one would imagine they carry the tribute of all the kingdoms of the east, and that one of those voyages alone was capable of supplying all Tartary with a sufficiency for its subsistence for several years. But Pekin alone receives the benefit of it; and this would be scarcely any, did not the province contribute besides to the maintenance of the inhabitants of that vast city, the circumference of which is six great leagues, allowing thirty-six hundred paces to a league, and contains at least two millions of people; and it has been judged to contain not less than six millions of souls, and that the two millions are only men, without reckoning women and children: but the exact number is very difficult, if at all, to be ascertained.

“ The Chinese not only make canals for the convenience of travellers, but they also dig many others, to catch the rain water which comes down from the mountains, and with which they water the fields in time of drought, more especially in the northern provinces. During the whole summer, you may see the country people busied in raising this water into abundance of small ditches or channels, which they cut across the fields. In other places they contrive great reservoirs of turf, the bottom

4

of

of which is raised above the level of the ground about it, to serve them in cases of necessity : besides, they have every where in the provinces of Xenfi and Xanfi, for want of rain, certain pits from twenty to a hundred feet deep, from which they draw water with incredible labour. If by chance they meet with a spring of water, it is worth observing how carefully they husband it ; they sustain it by banks in the highest places ; they turn it here and there an hundred different ways, that all the country may reap the benefit of it ; they divide it by drawing it by degrees, according as every one hath occasion for it ; insomuch that a small rivulet, well managed, sometimes dispenses fertility to a whole province."

To the above accounts of the canals of China I shall now add some description of those in other parts of Asia, which, I doubt not, will be highly acceptable to the curious enquirer on this subject, as it tends to shew the skill and intelligence of the natives of that quarter of the globe, their ideas of the advantages of inland commerce, and with what indefatigable industry they have laboured to promote it. The following account of the canals and inland navigation of Hindoostan, or the Mogul empire, more commonly known by the name of Bengal, is extracted from Mr. Rennel's *Memoirs of Hindoostan*, published in 1788.

"The countries between Delhi and the Panjab being scantily supplied with water, the emperor Feroze III. undertook the noble as well as useful task of supplying it better, and at the same time meant to apply the water so furnished to the purposes of navigation. Dow (vol. i. p. 327) translates Ferishta thus :

'In the year 1355, Feroze marched to Debalpour, where he made a canal one hundred miles in length, from the river Suttuluz to the river Lidger. In the following year between the hills Mendouli and Sirmore, he cut a canal from the river Jumma, which he divided into seven streams, one of which he brought to Haffi, and from thence to Beraisen, where he built a strong castle, calling it by his own name. He drew soon after
a canal

a canal from the river Caggar, passing by the walls of Sirsutti, and joined it to the river of Kera, upon which he built a city, named after him, Ferozeabad. This city he watered with another canal from the river Jumma. These public works were of prodigious advantage to the adjacent countries, by supplying them with water for their lands, and with a commodious water-carriage from place to place.'

"We learn also from the Ayin-Acbaree (vol. ii. p. 107, English translation), that Feroze founded the city of Hissar, called also Hissar-Feroozeh, and dug a canal from the Jumma to it; and we find moreover that the canal from the Jumma at Kungiparah to Delhi, was the work of Feroze, and is probably one of the seven canals mentioned by Ferishta. I apprehend, then, that Hissar, or Hissar-Feroozeh, of the Ayin-Acbaree, is the same with the Ferozeabad of Ferishta. But possibly Feroze might only embellish and increase the fortifications of Hissar, and then give his name to it, a practice very common in Hindoostan, to the utter confusion of historic records, and with no less injustice to the original founders. The town of Sirsutti, by the authority of MS. maps and other circumstances, I place on the river of that name, between Tannafar and Kythil (or Kuteil), and Haffi or Hansi, on the west or south-west of Kythil. Hissar, or Ferozeabad, will occupy a place still farther to the south-west, and in this position will be about seventy-five cosses from Delhi, in a west or north-westerly direction, and about one hundred miles from Setlege or Suttuluz, at the nearest part of Debalpour, from whence the canal was said to be drawn. The rivulet of Kera I cannot trace any more than the lidger; but I think it will appear as clear to the reader as to myself, when the text and the different positions in the map are considered (the last complete one of Hindoostan published I suppose him to have now before him), that these different canals had for their immediate object the junction of the Setlege and Jumma rivers, and remotely that of the Indus and Ganges; although they do not allow us to comprehend the whole scope of Feroze's plan of inland navigation. By a slight inspection of the map it will appear that this project would, if the ground be admitted

mitted of its being successfully put into execution, be one of the greatest undertakings of the kind that ever was projected, that of cutting through the isthmus of Suez only excepted. We should then have seen two capital rivers, which traverse a large part of the continent of Asia, which enter the sea at one thousand five hundred miles asunder, and which stretch out their arms, as it were, to meet each other, united by art (canals), so as to form an uninterrupted inland navigation from Cabul to Affam. I take it for granted that this canal was never completed, otherwise we should have heard more of it, as we have of the canals before described, leading from the river Jumma. The distance between the navigable parts of the Jumma and the Setlege, is not above one hundred and twenty miles direct.

The Ganges and Burrampooter rivers, together with their numerous branches, intersect the country of Bengal (which, independent of Bahar and Orissa, is larger than Great Britain) in such a variety of directions, as to form the most complete and easy inland navigation that can be conceived. So equally and admirably diffused are those natural canals, that little is left for art to perform in a country that approaches so nearly to a perfect plane, that, after excepting the lands contiguous to Burdwan, Birboom, &c, &c. which may be reckoned about a sixth part of Bengal, we may safely affirm that every other part of the country has, even in the dry season, some navigable stream within twenty-five miles at farthest, and more commonly within a third part of that distance.

It is supposed that this inland navigation gives constant employment to thirty thousand boatmen; nor will this excite our surprise, when it is known that all the salt, and a large proportion of the food, consumed by TEN MILLIONS of people, are conveyed by water within the kingdom of Bengal and its dependencies. To these must be added, the transport of the commercial exports and imports, probably to the amount of two millions sterling per annum; the interchange of manufactures and products
D throughout

throughout the whole country; the fisheries, and the article of travelling. The vessels made use of vary in bulk from one hundred and eighty tons down to the size of a wherry. Those from thirty to fifty tons are reckoned the most eligible for transporting merchandise.

The rivers are in a tranquil state from the time of the change of the monsoon in October to the middle of March, when the north-westerns begin in the eastern part of Bengal; and these winds are the most formidable enemies that are met with in this inland navigation; they are sudden and violent squalls of wind and rain, and, although of no long duration, are often attended with fatal effects, if not carefully guarded against: whole fleets of trading-boats have been sunk by them.

During the long interval between the end of the rainy season and the beginning of the north-westerns, the navigator is secure with respect to weather, and has only to observe a common degree of attention in piloting the boat clear of shallows and stumps of trees; the rate of motion must principally determine that of the boat, for the motion acquired by the oars of a large budgerow* hardly exceeds eight miles a day at ordinary times. From the beginning of November to the latter end of May, the usual rate of going with the stream is forty miles in twelve hours, and during the rest of the year from fifty to seventy miles. The country, as I observed before, is nearly a plane; to prove which, a section of the ground parallel to one of its branches, in length sixty miles, was taken, and found to have only nine inches descent in a mile; but the windings of the river were so

* A budgerow is a travelling boat, which is used in these inland navigations, constructed somewhat like a pleasure barge: some of them have cabins, fourteen feet wide and proportionably long, and which are fitted up genteelly, according to the company they carry and price of carriage: these boats draw from four to five feet water.

great as to reduce the declivity, on which the water ran, to less than four inches per mile.

The medium rate of motion of the Ganges is less than three miles an hour in the dry months. In the wet season, and during the draining the waters from the inundated lands, the current runs from five to six miles an hour; but there are instances of its running seven and eight miles an hour.

C H A P. III.

Canals of Russia—The first begun by Colonel Breckell, a German, who failed in the Attempt, and fled the Country—Captain Perry employed by the Czar, Peter the Great—Three different Surveys of Captain Perry—Account of the celebrated Canal and Locks of Vishnei-Voloshok—Navigation up the Twertza to Vishnei-Voloshok—Navigation from the Caspian Sea to the Baltic—Prodigious Number of Vessels employed in this Inland Navigation—Course of the Inland Navigation from Kiatka, the Frontier Town of Russia, next to China, to Moscow, and Petersburg—Great Extent of this Navigation—Trade carried on by it between China and Russia.

PETER the Great, czar of Muscovy, having observed, while in Holland, that the industrious inhabitants of that country had, by diligent perseverance, and principally by the means of canals, raised a small tract of marshy land into a populous and powerful state, this great prince, among his other grand designs, formed the plan of an inland navigation for conveying the rich commodities of Persia to his new city of Petersburg. They were first to be transported by the Caspian sea to Astracan; and thence, through the mouth of the river Wolga, and by a conjunction of canals, into the river Mesta, and the lake Novogorod; and thence into the lake Ladoga, and by the river Neva to Petersburg; being a course of four hundred and sixty miles. He likewise projected a communication between the rivers Don and Wolga, which were to join the river Occa by another canal, and thus effect a navigation to Moscow by the river Mosca; and afterwards, by several other canals of communication, through the river Dwina, to the city of Archangel on the White sea. And lastly, the productions and
commo-

commodities from Archangel and the adjacent countries were to be conveyed through the river Onega to lake Onega by a canal ; and also through lake Ladoga, which lies at the foot of the gulf of Finland, by the river Neva, to Petersburg. But the death of this great monarch prevented the perfect completion of this noble undertaking, which would perhaps have rendered Petersburg the most populous city, and best place of traffic in the world.

In the year 1698 this work was begun by one colonel Breckell, a German, who was a colonel in the czar's army, and who had the reputation of a good engineer as to fortifications, but very little understood the business of making canals. The first sluice he made was blown up, the water taking its course under the foundations on the approach of the first flood, and before it was well completed, at the first shutting the gates ; in consequence of which Breckell, when he went to Moscow the following winter, obtained a pass, as for one of his servants, whom he pretended he must send for necessaries for the work, and with the said pass made his escape out of the country.

During this first year he had twelve thousand men under his command, employed in digging, cutting down timbers, &c. &c. whose time and labour were all lost in one night.

This year the czar of Muscovy was in England (on his tour of Europe), and by the recommendation of the Marquis of Caermarthen and Mr. Dummer, then surveyor of the navy, engaged and employed captain John Perry as a person every way qualified to serve his majesty, as well in his designs of establishing a fleet, as making his rivers navigable, where not so by nature, and cutting artificial canals to join them, to effect an inland navigation through a great part of the country. Captain Perry was engaged at a salary of three hundred pounds sterling a year, and twenty-five roubles * per month subsistence money, with

* A rouble is four shillings English, sometimes four shillings and six-pence.

all travelling charges, besides the promise of a handsome reward at the conclusion of any work when finished.

Captain Perry was immediately sent to Moscow, with orders, that on his arrival there he should be directly forwarded to the province of Astracan, a thousand wersts or Russian miles (a werst, or wurst, is about three quarters of an English mile) beyond Moscow, to survey the work which colonel Breckell had begun; and on his arrival there he found the work blown up, and colonel Breckell gone, as has been before related.

Upon this work captain Perry was employed three summers successively, with orders to have thirty thousand men to work; but he seldom had above half that number; and the last year not ten thousand men, nor the necessary artificers, or materials sufficiently provided; for the governor of Astracan, and all the principal boyars, or nobility of that country, obstinately opposed the undertaking, declaring it a thing impossible to be effected by the hands of men. The governor represented it as burthenfome to the country, from the great numbers of men employed in it, and used all his endeavours to cause it to be abandoned as impracticable; saying, that God had made the rivers to go one way, and it was presumption in man to think to turn them another.

The czar having been defeated by the Swedes at the battle of Narva, in the latter end of the year 1701, captain Perry received orders to meet the emperor at Moscow, and to let all the works stand still; leaving one of his assistants there to take care of what was done, some of the sluices being finished, others nearly so, and the canal half dug.

In the year 1702 captain Perry was sent to Veronize, a city situated on a river of the same name, which falls into the Don, to fix on a place near the mouth of that large river, to lay the czar's navy upon
4 blocks

blocks on dry land to repair, by damming up the river, &c. ; which navy was to act against the Turks ; and here we will leave captain Perry till the year 1707 or 1708, building and repairing ships of war (one of which was of eighty guns), making a dock-yard, sheds for the ships to lie dry, warehouses, storehouses, &c. &c.

The czar having, at this time, formed the great design of building a new city at the mouth of the river Neva, which runs out of lake Ladoga into the Baltic sea, captain Perry was again called from ship-building, and ordered to attempt three several ways to cut canals from the great river Wolga, and other rivers, to bring timber, provisions, &c. from the interior parts of the country to the new city Petersburg.

Captain Perry therefore departed, with assistants, from the side of lake Ladoga to the river Wolga, to trace the several rivers as they fall into each other, to the places where, at the heads, or first springs from whence they take their rise, they approach nearest, and a communication may be most easily effected. He accordingly took the descent or difference of level of the said several rivers, as they fall down into the Wolga on the one side of the country, and discharge themselves into lake Ladoga on the other, with such observations as were necessary to be made ; and returned, at the end of the year 1710, to give an account of what he had done to his majesty, who was then at his new city of Petersburg ; and to lay before him the draughts, levels, rises, and falls, and a report of the properest place, the time required, and the expences necessary for making such communications, by the way of the river Koeffha, lake Beila, and the river Shackna, on the one side of the country, falling into the Wolga near the town of Rebna ; and by the way of the river Whitigor, lake Onega, and the river Swire, falling into the lake Ladoga on the other side of the country ; where it was necessary only to construct twenty-two locks or sluices, and to cut an easy canal not three English miles in length. A draught of this intended communication, with an estimate of the time and expence which
would

would be necessary for its completion, he presented to the czar, who received them very graciously.

The following short abstract of the survey will probably not be unacceptable to the curious reader:

The first survey of the country was by the way of the rivers Sals and Tiffin, to the top of the high land within the country, whence an arm of the river Tiffin takes its first rise. He found the same the whole way, with abundance of falls, descending into the lake Ladoga through a distance of one hundred and seventy-four Russian wersts, winding as the rivers take their course, to be difference of level eight hundred and ninety-seven English feet; and from the top of the said high land in running on the other side of the country, four hundred and twenty miles, down the rivers Chacodoshea and Molloga, to the place where the river Shackna falls into the Wolga, the descent was found to be five hundred and sixty-two feet.

The second route captain Perry took was by the way of the river Emsta and lake Elmena, and the river Volkoff falling into lake Ladoga: in running a course of five hundred and fifty wersts, the descent was found to be five hundred and sixty-eight feet; and on the other side of the country, southward, descending by the way of the rivers Twere and Wolga, as far as the mouth of the river Shackna, aforesaid, in running seven hundred and twenty wersts, the descent was found to be two hundred and thirty-three feet.

The third route of the aforesaid engineer was by the way of the river Whitigor, lake Onega, and the river Swire, falling into lake Ladoga; and in the running of two hundred and seventy-eight wersts, the descent was found to be but four hundred and forty-five feet from the top of the highest land, where the rivers come nearest for a canal to be cut; and the descent down on the other side of the country, in running four hundred

hundred and eighteen wersts by the way of the rivers Keoffha, lake Beila, and Shackfna, falling into the Wolga at the same place before mentioned only one hundred and ten feet.

This being the lowest or most level part of the country, attended with the least falls, and requiring the least number of locks to be made, and the rivers Swire and Shackfna, and a great part of the rivers Koeffha and Whitigor, being already navigable for small vessels which pass the whole year backwards and forwards, except only when the rivers are frozen; Captain Perry there recommended the last survey to his Czarish Majesty as abundantly preferable for making the intended communication and canals*.

What was left undone by Peter the Great has been carrying on and completing, with the utmost assiduity, by his successors; and a communication is now effected between the Baltic, or rather the Ocean, and the Caspian sea, by which a navigation is opened to Persia: a new communication with the river Wolga is likewise undertaken, the old one being found so dangerous as to be almost useless.

Several other works of this kind are carrying on, for the benefit of trade and commerce, by order of the present empress, in different parts of her extensive dominions; and the most experienced and able engineers have been engaged from every country in the world; which will not fail to render Petersburg, what Peter the Great intended it should be, the emporium of the North, if not of Europe.

A short sketch of the works carried on in Russia for the improvement of inland navigation, since the death of Peter the Great, some of which, as I have before observed, were begun by him, and perfected by his great successors, will shew the attention there paid to the internal commerce of that vast country: and when we consider the great labour

* See Perry's State of Russia.

and prodigious sums of money those canals must have cost, we shall be astonished that they ever were completed, since Russia has been almost continually engaged in expensive wars since they were first undertaken.

There is perhaps no part of the world where inland navigation is carried through such an extent of country as in Russia, it being possible in that empire to convey goods by water *four thousand four hundred and seventy-two miles*, from the frontiers of China to Petersburg, with an interruption of only about sixty miles; and from Astracan to the same capital, through a space of *one thousand four hundred and thirty-four miles*; a most astonishing tract of inland navigation, almost equal to one fourth of the circumference of the earth.

The communication by water between Astracan and Petersburg, or between the Caspian sea and the Baltic, is formed by means of the celebrated canal of Vishnei-Voloshok. This great work, which was begun and completed under the reign of Peter the Great, has been so considerably improved by order of the present empress (1780), that vessels now reach Petersburg in less than half the time they formerly employed.

By examining the map of Russia, we find that the Twertza joins the Wolga at Iver; that the Shlina forms the lake Maftino, which gives rise to the Mafta; that the latter falls, after a course of about two hundred and thirty-four miles, into the lake Ilmen, from which issues the river Volkof, which runs one hundred and thirty miles to the lake Ladoga, which supplies the Neva; so that in effect the Shlina, the Mafta, the Volkof, and the Neva, may be considered as the same river flowing into and through different lakes, and only changing its name at various intervals. By uniting therefore the Shlina, which communicates with the Baltic, with the Twertza, which flows by the Wolga into the Caspian sea, is formed the junction of those two seas. This
junction

junction is made by the canal of Vishnei-Voloshok, where the Shlina is united to the Twertza by the following canals and rivulets.

Close to Vishnei-Voloshok, the Shlina is formed by the confluence of the two rivulets Shlina and Zna; near the latter are the sources of the Twertza. In order to join the Twertza with the Zna, the following works were made under the reign of the czar Peter the Great.

Near the village of Klutshina a canal was dug to the small lake of the same name, a second canal was dug to the lake of Gorodolub, and a third canal was dug from thence to the Zna. At the same village, just below the first canal, a lock of four gates was constructed across the Shlina, in order to stop the course of that rivulet, and, by means of the said canals and lakes, to convey water to the Zna above Vishnei-Voloshok. But to keep this supply of water in reserve, and to let as much into the town as is judged necessary, a great lock of seven gates was constructed across the Zna, below the third canal. The Zna and the Twertza were united by a canal, beginning from the sources of the latter, and at the end of the canal a lock was made. The natural course of the Zna was shut up by two locks in the town, one of which may also serve for a passage. A canal was dug from the Zna to the Shlina, at the end of which is the lock of Zna.

The several canals are supplied with water, and the vessels are navigated from the Twertza into the canal of the Zna, by the following operation of locks.

The locks of Klutshina, and those in the town of Vishnei-Voloshok, and that of the Zna being shut, the lock of the Twertza is opened; the waters of the Zna and Shlina are conveyed through the canal of the Twertza into that river; and the barks and barges pass into the Zna at Vishnei-Voloshok. When a sufficient number have been admitted, the lock of the Twertza is shut, and the waters being raised to

a certain level, which it seldom takes more than two or three days to effect, by means of the lock of seven gates, that of the Zna is opened, and the vessels are gradually let down a small fall, to the number of about twenty in an hour. At night the lock is shut. If on the following day there is sufficient depth, the vessels keep descending through the lock of the Zna; or, if not, they must remain for a day or two until there is a sufficient body of water collected. Having by these means all passed into the Shlina, they proceed without interruption through the lake Mastino to the beginning of the Mafta, where a lock has been lately constructed which holds the waters of this lake in reserve. By this reservoir the navigation is so greatly facilitated, that the lock of the Zna being shut, and that of the Twertza open, the latter river, which was formerly almost dry during several weeks, is now generally navigable, even in the midst of summer, within two days after the passage of the vessels: in spring the supply of water from the melting of the snows is so very considerable, that the locks, both of the Twertza and of the Zna, are open at the same time.

With respect to the navigation of the Mafta, several rivulets falling into it are confined by locks, which being opened successively as the vessels are passing, fill the river, and render the shallows navigable; and, being again closed, hold perpetual reservoirs of water for the same purpose: this operation is performed five or six times in the summer. By some other works lately constructed, a considerable addition of water has been obtained; and it is expected that the Twertza will become always navigable, and that the lock of the Mafta will only be shut for a short time.

The boats employed on this occasion are towed by ten horses, at the rate of ten or twelve miles a day, up the Twertza to Vishnei-Voloshok, from which place they are rowed as far as Novogorod. Each vessel is provided with at least ten men; those which are laden with hemp require twenty-two men. At Noshino and Bassatino they change pilots,

pilots, and take in ten additional men to pass the upper and small cataracts. At Apezenkoi-Radok, which stands at the head of the great cataracts, they procure another pilot and two assistants, and, on account of the rapidity of the current, increase their complement generally to sixty men. The fall of the river is one hundred and twenty-two yards and a half perpendicular in twenty miles, and the stream is so violent, that the vessels not unfrequently shoot along this space within the hour; but they are sometimes dashed against the rocks, or overset by accident. In the year 1778, above thirty vessels were lost.

From the foot of the great cataracts the pilot of Vishnei-Voloshok steers the vessel one hundred and twenty miles further down several shoals, which, however, have been considerably reduced, and almost levelled. In spring the vessels may be allowed to draw two feet and a half water, in summer only twenty-six inches. In autumn the navigation from Vishnei-Voloshok to Petersburg is performed in little more than a month, in the summer in three weeks, and in spring only a fortnight is required. In the year 1777 three thousand four hundred and eighty-five vessels passed through the canal: this alone shews the amazing internal trade of Russia, and from one quarter of the country only. The vessels being steered down the Mašta, across the lake Ilmen to Novogorod, descend the river Volkof; and the Ladoga canal, which does not enter the lake Ladoga, but passes up from near the mouth of the river Volkof, and winds its course on the borders of lake Ladoga to the river Neva, which it enters near the village of Schluffelburg, and then proceeds to Petersburg.

This canal was begun in 1718 by order of Peter the Great, and was finished during the reign of the empress Anne: it was carried at first only as far as the small village of Kabona, to a rivulet of the same name, which falls into the lake to the east of Schluffelburg, but now reaches without interruption from the Volkof to the Neva. Its length is sixty-seven miles and a half, and its breadth seventy feet; its mean depth
of

of water in summer is seven, and in spring ten feet ; it is supplied by the Volkof and eight rivulets ; the latter being received into reservoirs, are admitted into the canal by means of flood-gates ; and the superfluous water is discharged through an equal number of openings on the opposite side. The vessels enter through the locks and sluices of the river Volkof, and go out through those of Schluffelburg. In 1778, four thousand nine hundred and twenty-seven vessels passed through the canal of lake Ladoga ; an increase of inland commerce of almost one fourth in one year by means of canal navigation.

A scheme has been lately projected to form a canal, so as to effect a communication between lake Ladoga and Bielo-Ozero to the Duna, in order to unite the White sea and the Baltic, and to improve the inland commerce of another part of the country, viz. that between Archangel and Petersburg. The only part of this plan yet finished, is a short cut of about seven miles from the Volkof to the Sejas.

The grand project of uniting the Caspian sea and the Baltic with the Black sea, by the junction of the river Don with the river Wolga, was planned by Peter the Great. These two rivers approach each other within the distance of forty miles in the province of Astracan ; and the two rivulets Ilofla and Camashinska, the former of which falls into the Don, and the latter into the Wolga, are only separated by an interval of land of about five miles. Could these two rivulets be made navigable, and united by a canal, the Black sea would be joined with the Caspian sea and the Baltic. With this view Peter the Great sent captain Perry, an English engineer, as I before observed, to the spot : the canal was begun under his inspection, and a cut was actually made a mile and a half ; but the scheme was dropped then for reasons before given. It has been revived, however, by the present empress, and professor Lovitz was intrusted with the execution of it. Having taken a level of the ground between the river Ilofla and the river Camashinska, he traced out the canal, and was preparing to begin the work, when in

1774 he was wantonly murdered by the impostor Pugatschef. According to the plan of Lovitz, the direct distance between the two rivulets is only five miles: but the great difficulty would consist in deepening their beds, and procuring a supply of water sufficient to make them navigable. As the Don, however, is only forty miles from the Wolga, and land carriage in this country extremely cheap and easy, it is imagined that the advantages resulting from the projected canal would be scarcely equivalent to the expence of making it.

I shall here add a short account of the frontier places of commerce between the Russians and Chinese, the commodities in which they traffic, and the route of the Russian Inland Navigation.

At a great distance up the river Yenisey, which empties itself into the Frozen ocean, or sea of Kara, beyond Nova Zembla, near a town called Yeniseik, a large branch takes an immense sweep to the north-east. This branch is called Zunguska river; and after running full ten degrees in that direction, turns nearly due south. Out of it fork several rivers, called the Ilim, Irja, Oka, and Angara, which last is the principal, and forms a very large body of water, not less than eight degrees in length and two in breadth, called the lake of Braikel, in which are a great number of islands, some of them very large. From nearly the middle of the lake lengthwise, another large river goes off still farther south, on the first branch of which stands the town Udinsk; and on the second branch the town Selenginsk, which is the chief town of the frontier government of Russia. The next branch is called the Kiatkar, and on the fork of this river is the Russian town Kiatka; and on the opposite side of the river, the Chinese frontier town Mait-matschin, which is their commercial town at the extremity of the Chinese frontiers next to Russia. At this place the rivers Tchikoi, Bura, Tola, Orchon, and Selenga, go off, and some of them branch again, and end in lakes. The Russian frontier commercial town, Kiatka, lies (according to Pallas's Travels through Siberia to China) in
lon.

lon. $124^{\circ} 18'$ E. from Ferro, and lat. 51° N. and is distant 3676 miles from Moscow, and 1025 from Pekin. The frontier Chinese town, Maitmatschin, is on the opposite side of the river, which is only about one hundred and forty yards wide, and lies to the south of Kiatka.

The principal commodities which Russia exports to China are furs and peltry : the most valuable are the skins of sea otters, beavers, foxes, wolves, bears, Bucharian lambs, Astracan sheep, martens, fables, ermines, grey squirrels, &c. Cloths, English, Prussian, and French ; camblets, calimancoes, druggets, white flannels, rich stuffs, velvets, coarse linen, Russia leather, glass ware, looking glasses ; hardware, as knives, scissars, locks, &c. ; tin, Russian talk, camels, horses, and horned cattle. The Chinese also purchase at a great price hounds, greyhounds, barbets, and dogs for hunting wild boars.

At Kiatka, the finest Hudson's Bay beaver has been sold at twenty roubles a skin, or about five pounds English money, and otter skins at thirty-five roubles, or eight pounds twelve shillings ; and the best Canada black fox skin has been sold for one hundred roubles, or twenty pounds English.

The commodities imported from China by Russia are : Raw and manufactured silk (the raw is prohibited in China under pain of death, but it is smuggled to Kiatka) ; raw and manufactured cotton ; teas of the best sort ; porcelain, japan cabinets, and cases, lacquered and varnished tables and chairs, boxes inlaid with mother of pearl, &c. fans, toys, and several small wares ; artificial flowers ; tiger and panther skins ; white-lead, vermilion and other colours ; canes, tobacco, rice ; sugar-candy, preserved ginger, and other sweetmeats ; rhubarb, musk, &c. &c.

The Chinese transport their goods to Kiatka chiefly upon camels. It
is

is five days journey from Pekin to the Chinese wall, and forty-six more to cross the Mongol desert to Kiatka.

In going to Kiatka they make the greater part of the journey by land, for two reasons : one is, that in most of the rivers the streams are rapid, and run the contrary way, which they take advantage of in returning ; and the other, that in the journey by land they collect in their route skins and furs, and various small articles for private trade.

The Russian commodities are transported by land from Petersburg and Moscow to Tobolsk : from thence the merchants sometimes embark upon the river Irtysh, and go down to its junction with the Oby : then they either tow up their boats, or sail up the last-mentioned river as far as Naryn, where they enter the river Ket, which they ascend to Makoffskoi-Ostrog, at which place the merchandize is conveyed about ninety wersts (sixty miles) by land to Yenirei : they then ascend that river, and the Tunguska and Angara to Irkutsk, cross the lake Baikal, and go up the river Selenga to Kiatka. It is a voyage of such difficulty against the streams eastward, that it is hardly finished in a summer ; for which reason the merchants often prefer the way by land, and rendezvous at the fair of Irbit, near Tobolsk ; from whence they go in sledges during winter to Kiatka, where they arrive about February, the season in which the chief commerce is carried on with the Chinese. But on their return they descend by the rivers Selenga, Angara, Tunguska, Ket, and Oby, to the junction of the latter with the Irtysh ; they ascend that river to Tobolsk, and go up the Tobolsk river into the Isset ; at the head of which is a small lake, whence a canal is cut into the river Tchusovaia, which falls into the Kama, which latter river falls into the Wolga near Kasan. The navigation of the Wolga, by Tzwer and Vishrei Voloshok, to lake Ladoga and Petersburg, I have before mentioned.

In order to give the reader some idea of that vast tract of country,

F

over

over which merchandise is frequently transported by land carriage in the journey from Petersburg to Kiatka, I shall add the following list of distances.

From Petersburg to Moscow, 734 wersts; from Moscow to Tobolsk, 2385; from Tobolsk to Irkutsk, 2918; from Irkutsk to Kiatka, 471. In all 6508 wersts, or 4338 English miles, and two thirds of a mile. The distance by the rivers is much greater, as has been already observed.

The Russian commodities are transported by land from Petersburg and Moscow to Tobolsk: from thence the merchants sometimes embark upon the river Irtysh, and go down to its junction with the Ob; then they either row up their boats, or sail up the last-mentioned river as far as Tyumen, where they enter the river Ket, which they ascend as far as Khatanga, at which place the merchandise is conveyed about ninety wersts (fifty miles) by land to Yurysk: they then descend that river, and the Tunguska and Angara to Irkutsk, and the lake Baikal, and go up the river Selenga to Kiatka. It is a voyage of such difficulty against the streamers eastward, that it is hardly finished in a summer; for which reason the merchants often prefer the way by land, and send some of the least bulky goods by Irkutsk; from whence they go in sledges during winter to Kiatka, where they arrive about February, the season in which the chief commerce is carried on with the Chinese. But on their return they descend by the river Selenga, Angara, Tunguska, Ket, and Ob, to the junction of the latter with the Irtysh; they ascend that river to Tobolsk, and go up the Tobolsk river into the Irtys; at the head of which is a small lake, whence a canal is cut into the river Tchouvis, which falls into the Kama, which last river falls into the Wolga near Kasan. The navigation of the Wolga by Twer and Wilhelms-Volostok, to Lake Ladoga and Petersburg, I have before mentioned.

In order to give the reader some idea of that vast tract of country,
 over

C H A P. IV.

Canals of Sweden and Denmark—Canal of Trolhaetta in Sweden—Numerous Obstructions and Impediments to its Completion—Prodigious Sums of Money and immense Labour that it has cost—Polhem employed on it by Charles XII.—His Plan, after an incredible Expence, and the Labour of several Years, proves abortive—Junction of the Lake Hielmar with the Maeler by a Canal—Junction of the Maeler with the Wenner—Canal of Carlsgraff—Difficulty of passing the Cataracts of Trolhaetta—Sluices constructed by Polhem described—Account of the Canal of Kiel, in the Duchy of Holstein—Length, Breadth, and Fall of this Canal—Its Utility, by effecting a Junction between the Baltic and the German Ocean.

SWEDEN has long been sensible of the utility of inland navigation. The following is a succinct account, principally extracted from the Travels of the judicious and accurate Mr. Coxe, of the most remarkable works of this kind, that have been constructed or projected in that country.

At the village of Trolhaetta in the province of Gothland, and on the river Gotha, close to the cataracts of that river, and near the entrance into the great lake Wenner, begins a stupendous work, intended to open a passage for vessels, by means of a navigable canal, called from this place the canal of Trolhaetta.

This canal forms part of a plan long projected by the Swedes, to

unite the Baltic and the German ocean by an inland navigation, as well for the purpose of improving the interior trade of the provinces, as of preventing the interruption of their foreign commerce, which is the inevitable consequence of a war with Denmark; for as all vessels sailing out of the Baltic must necessarily pass through the Sound, they are exposed to the Danish ships of war and privateers, who shelter themselves under the batteries of Elsinoor, which command the passage of the strait, unless a Swedish fleet should command the channel.

Gustavus Vasa was the first sovereign who perceived the utility of such an inland navigation, when he made Lodeſe, now Gotheborg, a staple town of trade, that the merchant ships coming to Sweden might not be obliged to sail through the Sound; and he conceived hopes, that, at some future period, merchandise might be transported from thence to Stockholm by means of the lakes Wenner, Hielmar, and Maeler, when the rivers and lakes which join them should be rendered navigable. Eric XIV. desirous to carry his father's designs into execution, gave orders for surveying the waters communicating with these lakes, and directed plans to be formed for joining them by artificial canals; but the execution of this great scheme was frustrated by the turbulence and misfortunes of his reign.

Several succeeding sovereigns had this great object in view. Charles IX. promoted it by the Carlsgraf canal, and Charles XI. by that of Arboga. The undertaking, however, of forming a communication by water through the whole country, was always considered as a work of extreme difficulty. Motraye says, that Gustavus Adolphus was inclined to encourage the design; but that as no person could be found in Sweden bold enough to engage in the enterprize, he adds, that Charles XI. sent for some Dutch engineers, who, after they had measured the falls of the waters between the lakes Wenner and Hielmar, declared it to be impracticable. Difficulties, however insurmountable they might appear

appear to persons of more sober understanding, were no obstacle to the genius of Charles XII. The same author informs us, that the celebrated engineer Polhem laid before that king a proposal for rendering the cataracts of Trolhaetta navigable; and for opening a communication, not only between Gotheborg and Stockholm, but also with the Wenner, the Vetter, and Nordkioping, sufficient for the passage of very large vessels. Polhem's plan was directly approved, and begun by Charles, ever fond of extraordinary projects; and though it was interrupted for some time by the king's death, it was again revived, with fresh vigour, under the late sovereign Adolphus Frederic.

This plan may be divided into three principal parts. 1. The junction of the Hielmar with the Maeler. 2. That of the Hielmar with the Wenner. 3. That of the Wenner with the German ocean.

First, the junction of the Maeler with the Hielmar. These two lakes are united by the small river Ulvifon, and the canal of Arboga: the former rises to the west of Arboga, flows through the town, and falls into the Maeler at Kungfaer. The canal of Arboga is cut from the Hielmar, and continued to the Ulvifon, about half a mile to the east of the town. It was begun in the reign of Christina; but, being only calculated for small vessels, was widened and deepened by order of Charles XI. and completed under his successor Charles XII. It belonged to the crown until 1769, at which period it had been so much neglected, as scarcely to be of any use; but a company of seven merchants of Orebro undertook to cleanse and repair it at their own expence, upon condition of receiving the toll of all vessels which shall pass through it. The canal is, excepting in a few parts, sufficiently broad to receive two vessels a-breast; its lower depth is eight feet. It is chiefly supplied with water from the lake Hielmar, the surface of which is eighty feet perpendicular higher than its level. It consists of eight sluices or locks. The vessels it admits are the same which navigate the lakes; they are decked and single-masted, seventy-six feet long, about forty-three tons burden, and draw
between

between six and seven feet water when they have taken in their lading.

2. In order to join the Hielmar and Wenner, it was proposed to open the navigation of the Swart-an, which falls into the western extremity of the Hielmar at Orebro ; to make a canal from that river to the lake Morken ; from thence by the Leton to the Skager ; and from the Skager, by the Gullspang, to the Wenner. There is reason to conclude, from the accounts of persons who have been on the spot, and inspected the above-mentioned rivers, that they are so shallow and stony, that it would be very difficult and expensive to render them navigable ; and as the faint attempts hitherto made upon the Gullspang have all failed of success, it has been proposed to cut a canal directly from lake Morken to Christinehamn, which is situated upon the eastern shore of the Wenner : but as no part of this project has been yet begun, and the whole would be attended with very great difficulties, there is little prospect that this branch of the great undertaking, the junction of the Hielmar and the Wenner, will ever be completed. On account of the almost insuperable difficulties attending the junction of the Hielmar and the Wenner, a plan was projected to form an inland navigation from the eastern coast of Sweden, south of the Maeler, by means of the Wetter, to the Wenner ; and in 1774 a map was published, with a view to shew the scheme to be practicable.

3. The junction of the Wenner with the German ocean is next to be considered ; and this might be accomplished by the river Gotha, which issues from the southern extremity of the lake near Wenneborg, and after a course of seventy miles falls into the sea near Gotheborg, provided that river could be made navigable throughout its whole course ; but as, on account of shoals and cataracts, its stream is greatly impeded, the communication has been attempted by the Carlsgraf canal, the canal of Trolhaetta, and the sluices of Akerstroem and Edet, which therefore I shall separately describe.

The channel of the river Gotha not being open and free, from its first issuing from the Wenner, a cut from a bay of that lake to the river was begun under Charles IX. but was not entirely completed before the reign of Charles XII. Polhem, whom I have mentioned before, erected by order of that monarch a sluice, which not being constructed upon a firm foundation, was scarcely finished before it was undermined, and carried away by the water. From that time the Carlsgraf canal remained without a sluice, and consequently without a vessel passing it, until the reign of Adolphus Frederic. In 1754 a new sluice was finished, which was called the sluice of Tessin, in honour of the prime minister of that name. It was formed by a subterraneous channel, forty feet long, eighteen broad, and twelve high; but these dimensions were too small for the admission of vessels of more than forty tons burden, and it frequently happened that even those could not pass, whenever there was either too much or too little water. To remove these difficulties, another sluice, called, in honour of the present king, the sluice of Gustavus, was completed in 1768. This superb work is a channel four hundred feet in length (the half of which is cut through the solid rock), and consists of two locks, each two hundred feet in length, and thirty-six in breadth; the sides are strongly faced with brick and stone. The greatest depth of water is thirteen feet, the lowest six feet. The usual vessels which navigate this canal are of eighty tons burden; but when the water is high, larger may pass. In 1777, one vessel of a hundred and thirty-three tons worked its way through.

From the end of this canal to the village of Trolhaetta, which includes a space of about five miles, the navigation of the river is uninterrupted; it flows in a gentle current, varies in its breadth from three hundred yards to a mile, and is in a few parts prettily sprinkled with islands; some of which are barren rock, others tufted with wood, and covered with arable soil. Near Trolhaetta, two ridges of mountains, which, on each side, run at a small distance from the river, approach its banks, and confine its stream within a narrow channel. In this place it is about four hundred

hundred feet in breadth, as smooth as a lake, and without any visible stream, exhibiting a striking contrast to the roaring of the torrent below. This smoothness of the water continues till it bursts at once into the cataracts of Trolhaetta, called the Gulfs of Hell, which render all farther navigation impossible. The bed of the river is solid rock; the banks are perpendicular; and, at the beginning of the fall, several granite islands, thinly strewed with underwood, junipers, and stubbed pines, rise in the midst of the stream, forming small straits, down which the water dashes with increasing impetuosity.

From the first opening of the fall to the part where the river again becomes navigable, is about two miles; but it does not roll through the whole of this space in one uniform sheet of water, or with equal rage and violence. It is divided into four principal cataracts, separated by whirlpools and eddies, and forming, during the whole way, the most awful scenes, ever varying, and too sublime to be accurately described. The perpendicular height of all the falls, considered as one, is about one hundred feet. From this description, the reader will readily perceive the extreme difficulty of rendering these cataracts navigable; and it was even through the midst of them that the daring projector attempted to form a canal, by the works I shall now proceed to describe.

Just above the first cataract, called Prastenkesdet fall, several dams were constructed which turned the stream, and left the main bed of the river quite dry. In this part some rocks were cut through, and others blown up; the bed was rendered level, and the cataract nearly turned into still water. To continue the navigation, an island of red granite, called Malg, which rises in the midst of the great cataract, was divided, and a canal formed through it of three hundred and forty feet in length, including a sluice of thirty feet. The depth of the fall, and of course of the perforated rock, is twenty-three feet four inches; the breadth eighteen feet. This is called Ekerbrad sluice, and was designed to consist of two locks. At a small distance another canal was formed on the side of the

the second great cataract. Through a kind of promontory, which projects into the stream, the solid rock of granite was hollowed eight hundred and sixty feet in length, fifty-six feet six inches in depth, and eighteen feet in breadth. This sluice was called Polhem's sluice, and was to consist of three locks, by which vessels were to be let down a fall of fifty-six feet six inches. At the distance of two thousand nine hundred and twenty feet, a third cut was made to the Flatesberg fall, terminating in the sluice of Elvius, the last of this projected plan. The length of the cut is twenty-eight feet, the breadth eighteen, and the depth or height of the fall thirty-four feet three inches. In order to form some idea in what manner the navigation was to be continued from the sluice of Polhem to that of Elvius, it will be necessary to give a descriptive view of the intervening space.

A little below the sluice of Polhem, the river dashes through a narrow passage, called Stampstrœm; from thence it gradually widens into a kind of bay, named Hoyon's warp: it is again cramped into a narrow channel by the nearer approach of rocks on each side, and forms a cataract, called Helvert's fall; at the extremity of which it expands itself into a small basin, called Ali-Halla; and then again precipitates itself at the Flatesberg fall, from whence it becomes navigable. Instead of continuing any works through the cataracts, or by the side of the river, the communication between the sluices of Polhem and Elvius was attempted in the following manner: A dyke of stone was constructed across the river, just below the Flatesberg fall and the sluice of Elvius, and forming a level with the bottom of Polhem. This chimerical project, which seems rather too ridiculous to have been seriously entertained, was however attempted. The king himself visited the work, and all Sweden was in eager expectation that the favourite project of the nation would at length be completed. The dyke was built; the river had risen twelve feet of the thirty-four; when, in an instant, the weight of waters burst the barrier too feeble to restrain them, and swept away in an instant the labours and expence of several years. The im-

menfity of the expence will be beft conceived by confidering that all the cuts were made through the folid rocks of granite. Large fubfidies had been annually raifed for the profecution of the work, and the national bank had readily advanced ftill greater loans; the fum total of which has never been divulged. The failure of the project, after fuch immense labour and enormous expence, occafioned great difcontent among the people; many of whom to this day believe, though there feems no foundation for the fuppoftion, that the projectors, bribed by the Danes, purpofely proceeded upon a plan which they knew could not fucceed. But thus much is evident: that throughout the whole undertaking, the works, ftupendous in themfelves, were conducted without proper care and attention; for, after all, the cuts which had been excavated with fuch difficulty, being only eighteen feet in breadth, would have been too narrow to have admitted veffels of fuch fize and burthen as ufually navigate the lake Wenner. In a word, feveral ill-judged meafures feem to have been taken; otherwife, although there were many natural obftuctions to the fuccefs of the enterprife, yet greater obftacles have been furmounted. But Polhem was not a BRINDLEY.

In confequence of this failure, all the works and fluices hitherto raifed were neglected as totally ufelefs, and a new plan for the canal of Trolhaetta has been projected; according to which, inftead of being carried, as before, along the channel of the river, it is to be cut through the folid rock that forms its banks. The plan of this laft project is thus defcribed: The length is to be four thoufand feven hundred feet, the breadth thirty-fix feet, and the depth, in fome parts, fifty feet or more. It is to confift of nine fluices; and when we reflect that the whole of this cut muft be hollowed through the red granite, it is evident that it will be attended with many, if not more difficulties, than were experienced in the former attempt. It muft by no means, however, be condemned as impracticable. The canal of the duke of Bridgewater, that of Languedoc, and the road through the mountain Gemmi, in Switzerland,

Switzerland, prove that scarcely any thing is impossible to human industry.

The chief question, in this respect, seems to be, whether the enormous expence attending the execution of the work, will be compensated by the advantages resulting from its completion. And here, if we merely take into consideration the navigation from the Wenner to Gotheborg, we may venture to decide in the negative. But if we presume, that at any future period a communication will be formed from the gulf of Bothnia to the Wenner, as in that case the cataracts of Trolhaetta would be the only remaining interruption to the inland navigation from the eastern to the western coast of Sweden, the accomplishment of this canal could not surely be obtained at too dear a rate.

His present majesty, who soon after his accession visited these works at Trolhaetta, wisely ordered them for the present to be suspended; but that the sluices of Gustavus and Aker should be finished without delay. Meanwhile, in order to facilitate the transport of merchandise from the districts bordering upon the Wenner to Gotheborg, a wooden road has been constructed on the side of the river, from the beginning to the end of the cataracts. It is supported upon posts over the rocks, which, from their irregularity and roughness, would have been almost impassable for horses.

About a mile below the cataracts, the course of the river Gotha is again interrupted by a fall, called Akerstroem. Here a canal has been made through a rock which projected into the river; the length of it is one hundred and eighty-two feet, including the sluice, the depth twenty-six, and the breadth thirty-six feet. This cut was begun in 1774, and it was expected would be opened in 1781.

From Akerstroem the river is clear to Gotheborg, excepting at Edet,

where its passage is stopped by a bed of rocks rising in the midst of the stream. On one side of these rocks another cut has been made, six hundred feet in length, twenty in depth, but only eighteen in breadth. This work is ill executed, and in bad order. A petition had been presented to the king, that it might be repaired and improved to the same breadth as Aker sluice; and there was no doubt but that it would be done.

The iron, and other merchandise, is now conveyed over the lake Wennerborg, and thence through the Carlsgraf canal, and down the river Gotha to Trolhaetta. Upon coming to the cataracts, the goods are unloaded, and carried along the wooden road, about two miles, to the end of the falls. There they are again embarked, and passing through the Akerstroem and Edet sluices, supposing that they are by this time completed, arrive without further impediment at Gotheborg. In return, salt, spices, corn, tea, and other commodities of interior consumption, are sent up, by the same channel, into the provinces about the Wenner.

Thus, for more than a century, the schemes and efforts of all the engineers employed in Sweden, both natives and foreigners, to construct works of the greatest importance to the country, failed of success. In England, if I may be permitted the observation, were the same advantages to be expected from surmounting equal difficulties, I have not a doubt but engineers might be found to accomplish such an undertaking, and private individuals to begin and complete it, without any assistance from government.

D E N M A R K.

BEFORE I particularly describe the canal of Kiel, it may not be improper to give a short account of that capital of Holstein, being a part of his Danish majesty's dominions.

Kiel

Kiel possesses a university for the German subjects of Denmark, which was founded in 1650 by Christian Albert, duke of Holstein Gottorp, and has lately been considerably enlarged by his present majesty. It contains twenty-four professors, and about three hundred students. The town stands upon a small peninsula in a bay of the Baltic, and has a very commodious harbour for ships of the largest size. It is already one of the most commercial places of Holstein; and its trade will be still further augmented, when the inland navigation across the peninsula shall be completed.

The inland navigation for the junction of the two seas, is to be formed through the duchy of Holstein, by the canal of Kiel and the river Eyder, which runs by Rendsburg, and falls into the German ocean at Tonningen.

The canal begins about three miles north of Kiel, at the mouth of the rivulet Lewen-fawe, which heretofore separated Holstein from Sleswick, and will form a new boundary between those two duchies. The distance from its beginning to the last sluice at Rendsburg, is twenty-seven English miles; but as the river Eyder is navigable about six miles and three quarters above Rendsburg, and only requires to be deepened in some places, the cut which is necessary for the completion of the communication between the two seas, will be only twenty miles and an half.

The canal was begun in July 1777, and in April 1779 it had been carried about six miles, as far as Sucdorf; and it was computed that the whole would be completed in 1784. The work was performed by contract: one thousand and twenty-four cubic feet* of earth were to be taken out for eight shillings, and the whole expence was to amount to about two hundred thousand pounds.

* The foot used in Denmark is to the English as 21 to 22.

Between the Flemhuder lake and the rivulet Lavens is the highest point, on each side of which the waters take different courses to the Baltic and German ocean: in this part the ground must be opened to the depth of fifty feet. The perpendicular fall towards the Baltic is twenty-five feet six inches, and that towards the German ocean twenty-three feet; and the vessels will be raised up or let down by means of the six following sluices: Holtenau, Knorp, Sucdorf, Shinkel, Niederholten, and Rendsburg. The breadth of the canal is one hundred feet at top, and fifty-four feet at bottom; the sluices are twenty-seven feet in breadth, and one hundred feet in length; and the least depth of water is ten feet. The canal will be furnished with water as far as Steinwarp from the Eyder, and the lakes Flemhuder and Wester, and from thence to Rendsburg by the lake Wetter, from which flows a rivulet that joins the Eyder. Common merchant-vessels, of about one hundred and twenty tons burden, will be able to navigate this canal.

The utility of this important undertaking will be evident, from a mere inspection of the map of Denmark. It may be observed, that even the smallest vessels, trading from any part of the Danish dominions in the Baltic to the northern seas, must make a circuit round the extremity of Jutland, and are liable to be detained by adverse winds. This navigation is so tedious, that goods shipped at Copenhagen for Hamburg are, not unusually, sent by sea only to Lubec, and from thence by land to Hamburg. But the completion of this canal will enable vessels not exceeding one hundred and twenty tons, or not drawing above ten feet water, to pass immediately from the Baltic into the German ocean, and proceed without unloading to Hamburg; or sail to Holland, England, or other parts, which in times of war receive supplies from Denmark.

C H A P. V.

Canals of Holland—Extensive Trade carried on by them—Canals of Flanders—Their ruinous Condition at present.

TH E industrious Hollanders, from mere necessity, and hatred of their oppressors the Spaniards, have with the greatest labour cut such a multitude of canals in every part of the low, narrow, swampy, boggy provinces they inhabit, which can scarcely with propriety be called land, that for commerce, riches, and population, they may now vie with any other country on the face of the earth, in proportion to its size, not even excepting China.

One third, at least, of this country has been gained from the sea, by the means of vast dykes and mounds, some of which are twenty-one yards in thickness, and which must continually be kept in repair, with prodigious labour and at an incredible expence, to prevent the whole country from being inundated.

The seven united provinces, commonly called Holland, are intersected with innumerable canals, which it is not my intention to describe circumstantially, since that would be to give a geographical survey and history of the country. They may be compared, for number and size, to our public roads and highways ; and as the latter with us are continually full of coaches, chaises, waggons, carts, and horsemen, going to and from the different villages, towns, and capital cities ; so, on the former,

mer, the Hollanders, in their boats and pleasure-barges, their trekſchuyts and other veſſels, are continually journeying and conveying commodities, for conſumption or exportation, from the interior part of the country to their great cities and rivers. An inhabitant of Rotterdam may, by means of theſe canals, breakfaſt at Delft or the Hague, dine at Leyden, and ſup at Amſterdam, or return home again before night. By them alſo a prodigious inland trade is carried on between Holland and every part of France, Flanders, and Germany. When the canals are frozen over they travel on them with ſkaits, and perform long journeys in a very ſhort time ; while heavy burdens are conveyed in carts and ſledges, which are then as much uſed on the canals as in the ſtreets.

The yearly profits produced by theſe canals are almoſt beyond belief ; but it is certain that they amount to more than two hundred and fifty thouſand pounds for about forty miles of inland navigation, which is fix hundred and twenty-five pounds per mile, the ſquare ſurface of which mile does not exceed two acres of ground ; a profit ſo amazing, that it is no wonder other nations ſhould attempt to imitate what has been found ſo highly advantageous.

The canals of Oſtend, Ghent, Antwerp, Bruffels, &c. cannot at preſent claim much praiſe. This country has had its day of commerce, when Europe was in its infancy of improvement ; but it yet poſſeſſes great wealth, and is extremely populous ; it yet carries on conſiderable manufactures, although it is no longer the great mart for commerce, as it was two or three hundred years ſince. Its fortified towns, population, and canals, ſufficiently prove what it has heretofore been ; and it were to be wiſhed that its inhabitants, who have made a bold attempt to obtain liberty, were leſs under the influence of bigotry and ſuperſtition.

The cities of Flanders are no longer in the flouriſhing ſtate in which they were ſome centuries paſt. The canals, which were then numerous,
kept

kept in good order, and filled with vessels laden with merchandise from every part of the known world, are now entirely neglected and out of repair. Holland on one side, and France on the other, have not only encroached on their territories, but diminished their trade. The city of Amsterdam rose to opulence on their decline.

So early as the twelfth century the spacious forests of Flanders were cut down, and the soil was laid open to the rays of the sun; large canals were cut for inland navigation, which, while they drained the land, opened a communication for the inland commerce of the country. The river Scheld was compelled to yield up fruitful fields which had long been hidden beneath its waters, and was restrained within its channel by two prodigious dykes.

A spacious canal, a work of the sixteenth century, extends from Brussels (once the residence of the dukes of Brabant and Burgundy) to the Scheld; which, though not open to vessels of these provinces where it enters the sea, yet affords a communication with Holland, and, by the canals of Flanders, with the ocean. By this canal the city still carries on some traffic; and we find, at a distance from the ocean, and where there is no navigable river, a port filled with vessels of every kind, adapted to all the purposes of trade and pleasure.

The French, when masters of Brussels, respected the lofty trees of the *Cours*, or *Allée-Verte*, which borders this extensive canal. The outlets of the city lead, on every side, to a pleasant and fruitful country.

On the northern banks of the Scheld, in the county of Wafs, below Ghent, the prince of Parma, during the memorable siege of Antwerp, cut a canal which still remains.

The Flemish cities, situated in fertile plains, by the side of rivers and navigable canals, were advantageously placed for maintaining
H those

those multitudes of inhabitants which they formerly contained, and the advancement of that commerce for which they were soon distinguished. The free fairs, the origin of which is very ancient, and of which, though they are now of less utility, the remains are still to be found here, are supposed to have been first established in this country.

C H A P. VI.

Canals of France—Canal cut by Lucius Verus—Canal of Briere—Canal of Orleans—Canal of Bourbon—Junction of the Somme with the Oise—Particular Description of the celebrated Canal of Languedoc.—Trade carried on by that Canal—Other Canals in France—Canals proposed to be cut in that Country—Description of the magnificent Aqueduct of Maintenon, built by Louis XIV.—Canals of Spain—Canal of Arragon—Canal of Castile—Canal of Murcia—New Canal from the Escorial—Canal begun, but not completed—The interior Parts of Spain capable of great Improvement by Canals.

FRANCE furnishes us with numerous instances of industry and ingenuity, exerted in the construction of canals for inland navigation.

The first of which history gives an account was that projected by Lucius Verus, who commanded the Roman army in Gaul, under the emperor Nero, to join the river Moselle with the Rhine.

The canal of Briare, called also the canal of Burgundy, was begun under Henry IV. and finished in the reign of Louis XIII. It forms a communication between the Loire and the Seine, and consequently to Paris; it begins from the Loire at the town of Briare, passing by Châtillon-sur-Loire to Montargis, where it takes the name of the canal of Montargis; just above which town it joins the canal of Orleans, and then proceeds on in one canal by Chau, Landon, Nemours, and Moret,

and falls into the Seine near Fontainebleau. It is of the greatest utility to all this part of France, and even to Burgundy. This canal has forty-two locks and sluices; and by it Paris is supplied with corn, flour, and provisions, as well as the other productions of several provinces, such as Provence oils, dried fruits, hardware, muscadel wines, paper, and other merchandise; and in return the cloths and stuffs, camblets, &c. of Abbeville, Amiens, Rheims, Sedan, and Lille, are also sent by this communication to the southern parts of France.

The canal of Orleans, which joins this canal near the town of Montargis, was begun in 1675, to effect a communication between the Seine and the Loire near to the city of Orleans. It is considerably shorter than the canal of Briare, and has only twenty locks and sluices. By this canal the inhabitants perform by an inland navigation, in their *bateaux-roches* (coach-boats or water-coaches), a voyage (or journey) to the neighbouring towns, and even to the city of Paris itself. These vehicles set out at stated times and places, for the convenience of passengers, and conveyance of all sorts of goods. They are large and covered, and exceedingly well adapted for the purpose.

On this canal and the river Loire a number of small vessels are fastened to each other, and ascend upwards by sails when the wind serves; or, when that fails, are towed by men, seventy or eighty men sometimes working at a single rope.

The canal of Bourbon has been but lately undertaken; it is intended to effect a communication from the river Oise to Paris, to prevent, as far as might be in the power of human prudence, the possibility of a scarcity in that city.

The junction of the river Somme with the river Oise by means of a canal, which is called the canal of Picardy, affords a ready conveyance to Paris for the grain of Picardy; the sea-coal, wood, butter, copper, and
I spices

spices from the northern provinces of the kingdom, and from Holland. This canal begins at St. Quintin, and is cut to near the town of Ham on the river Somme, whence it crosses the country into the river Oise, near Lafere; from whence vessels proceed down that river to Chauny, where the river is navigable, into the Seine, and so to Paris, and by Rouen to the sea.

From the town of Landau a canal is cut into the Rhine, near Spires, which is called the canal of Landau.

The canal of Languedoc, called also the canal of the Two Seas, which forms a junction between the ocean and the Mediterranean, was first projected under Francis I. but begun and finished under Lewis XIV. It does honour to the able minister Colbert, and to Riquet, the engineer who conducted the work.

This amazing undertaking was begun in 1666, and finished in 1681. It has answered every expectation formed from it, and established a ready communication between the two fertile provinces of Guienne and Languedoc. This canal extends from Narbonne to Thoulouse. It receives several little rivers as feeders in the way, and is provided at proper intervals with one hundred and fourteen locks and sluices. In some places it is conveyed by aqueducts over bridges of incredible height and strength, which under them give passage to other rivers.

What appeared most extraordinary at that time was, that near the town of Beziers it was conveyed under a mountain by a tunnel (a method which has now become common) seven hundred and twenty feet in length, cut into a lofty arcade, and the greatest part of the way lined with free stone, excepting towards the ends, where it is only hewn through the rock, which is of a soft sulphurous substance. The expence of this work was thirteen millions of livres, about five hundred and forty thousand

land pounds, of which the king contributed seven millions, and the province of Languedoc the remainder.

I shall here give a concise description of this great work, the wonder of Europe, that modern engineers and projectors of inland navigations may be encouraged to encounter all difficulties that may oppose their patriotic labours.

This canal begins at Cette in the bay of Languedoc, and passes through the lake Thau to the town of Agde, where is a round canal basin with three openings, and three different depths of water meeting there ; and the gates or locks are of such ingenious construction, that the vessel may pass through by opening either of them, which the master pleases; a contrivance which excited admiration in the great Vauban himself.

Not far from Beziers, and beyond the tunnel already mentioned, are eight locks, which form a grand and regular cascade nine hundred and sixty feet long, and by means of which the vessels cross the river Orb, and, continuing their voyage on the canal, pass the towns of Beuers, Argens, Tresbes, Orbiell, Alzenne, Villepinte, into a large basin near Castlenaudury, which receives the river Laudet. At St. Ferriol, near the town of Reuel, Mr. Riquet constructed a reservoir to supply the canal, containing five hundred and ninety-five acres of water, which is first embanked, and then the embankment walled round with free stone, between two rocky mountains. Under this dam runs a vaulted arch or sewer, reaching to the main wall, where three large cocks of cast brass are turned, opened and shut by iron bars ; these cocks discharge the water through their mouths, which are as large as a man's body, into the aqueducts, and the basin at Norouse, which is the head of the navigation. The canal then descends from Norouse by Avignenel, Montequieu and Baziege into the river Garonne by three locks, about a quarter of a mile below the city of Thoulouse which it passes. Its breadth is one hundred

hundred and forty-four feet, towing-paths included; its depth six feet, and its length sixty-four French leagues. It is here to be observed, that Narouse is the highest part of the navigation, being about six hundred feet above the level of the two waters, from whence the ground has almost one continued descent to them on each side. On this spot, as was before observed, Riquet made his bason, and collected his waters; and hither he brought his current of water from the adjacent mountain by an aqueduct five leagues in length, which contained between five and six thousand cubic inches; and this stream being distributed in the two canals last mentioned, forms, in every part, a body of water of above six millions of cubic feet.

When a vessel or barge in its passage from Narbonne, after it has sailed through the canal that traverses the plain, has arrived at the foot of one of these locks, the gates are instantly opened, and the water so hemmed in rushes forth with impetuous violence, and, mixing with that in the canal, forms one common level: when the vessel sails into the lock and the gates are shut again, the water which descends from the upper lock rises by slow degrees several feet in height, seldom less than seven or more than twelve; the vessel accordingly rises with it till it comes to a level with the water contained in the second lock, by means of which a vessel that is coming from Narbonne may pass without any obstruction out of the first lock into the second, or one coming from Thoulouse may be introduced out of the second lock into the first, the gates of the second lock being shut: the vessel in the same manner mounts into the third; and thus it ascends from lock to lock till it comes to the top of distribution, and then by the same kind of conveyance falls down to Thoulouse. To preserve the level, they have been frequently reduced to the necessity of turning and winding the canal round hills and rising grounds, and to fortify it with an immense number of piles in those places where the earth was likely to give way. This canal was conveyed by water bridges and stone arches over valleys; hills, and mountains were levelled; while through others a passage was cut
7 and

and arched over, large enough for the vessels to pass under with their cargoes, with lights and air-holes at proper distances.

Above twelve millions of cubic feet of earth, and more than thirty thousand cubic feet of solid rock, have been removed to hollow out its bed. It has on it a hundred and fourteen locks. Sixteen prodigious large mounds have been raised to divert the course of such waters as might any way obstruct the passage of vessels; and twenty-four large spacious drains have been made to empty it, whenever there shall be danger of its being clogged up, or too full. On a moderate computation, there are above two hundred and forty thousand cubic feet of stone work in these erections, including a projection into the sea of two hundred fathoms, and a pier of five thousand fathoms more, which at present secures the port of Cette, and renders it a very commodious harbour; the advantage of which is the greater, as the coast of Languedoc has no havens whatever, and is very dangerous.

The expence of this astonishing work was nothing in comparison with its utility.

Notwithstanding France abounds with canals which intersect the country, and join not only rivers but seas to each other, to the great improvement of the internal part of the kingdom, and the encouragement of the husbandman and manufacturer, who thus find a cheap, easy, and ready conveyance for their commodities to a market and the metropolis; yet have we seen France, immediately on the conclusion of the American war, after the very active part she had taken in it, turning her attention to the advantages which Holland derives from her inland commerce. She is now imitating her example, and, at an enormous expence, actually cutting three canals or branches of great length to join the most navigable rivers, for the improvement of trade and manufactures. On the reduction of the army and navy in 1782, these canals were immediately begun, to give employment to
the

the disbanded foldiers and feamen, that thofe ufeul members of fociety might not be forced to emigrate to foreign countries, languifh in idlenefs, or ftarve in prifons; or, what is worfe, through want and neceffity, perhaps, come to an untimely death.

The firft of thefe three canals will extend the fpace of twenty-four leagues, from Chalon-fur-Saone to the town of Digoïn on the Loire, and form a junction of the river Saone and the Rhone with the Loire. It is to be called the canal of Dehune.

The courfe of the fecond canal will be from St. Jean-de-l'Aune to the village of Roch, between St. Florentin and Joigny, a fpace of fifty-two leagues. It is called the canal of Burgundy, and will open a communication between the Saone, the Rhine, the Yonne, and the Seine.

The third canal will begin from the village of St. Symphorin on the Saone, a little above St. Jean-de-l'Aune on the oppofite fhore, to the town of Dole on the river Doubs, and, paffing the city of Befançon, will be continued below Strafburg, and form a junction of the Saone and the Rhone with the Ill and the Rhine. A great part of this canal has been finifhed fome time. It is called the canal of Neufbriffac, and falls into the river Ill. The above great undertakings are purfued with fo much vigour and activity, and are expected to be productive of fuch great advantages to the moft valuable branches of manufactures, that, unlefs a delay fhould be occafioned by fome unforefeen accident, it is imagined they will all be very foon completed.

By thefe navigable canals there will be a cheap, eafy, fafe and certain conveyance of goods from Marfeilles, the Mediterranean, Italy, and Switzerland, to the bay of Bifcay and the ocean, and alfo to Holland and Germany, as well as to Flanders and all the Auftrian Netherlands; and during any future war with England, France will be able, by them, to fupply her dock-yards at Marfeilles and Toulon, as alfo her grand

arsenal and dock-yards at Brest and Rochefort, with all sorts of stores and commodities from the Baltic, without hazarding a voyage by sea; whereas they are now obliged to be brought from the Baltic down the English channel to Brest, and through the straits of Gibraltar to Toulon, at the utmost risk of becoming the prize of our ships of war and privateers; or they must go north about, which is a long and dangerous voyage.

Since the canal of Languedoc has proved of such advantage to the town of Cette and the adjacent country, other places have been induced to copy the example. From Cette another canal has been cut, called the canal of Grave, which goes into the lake Mauguis, near to the city of Montpellier; and another canal out of the said lake, to the town of Lunel, called the canal of Lunel.

There is another canal out of the bay of Languedoc, through two lakes, to the town of Beaucaire, on the river Rhone.

There is also another canal out of this canal, which proceeds to the village of Guveral, into the river called the little Rhone.

There is another canal from the town of Tarascon on the Rhone to the town of Arles on the same river, and down into the lake which falls into the bay near the mouths of the Rhone. It is called the canal of Boue.

Two other canals go out of this canal, one near the town of Arles, the other at the head of the aforesaid lake; and the latter is called the canal of Crapone, and goes into the river Durance near Mirandol.

There are three other canals out of this river, near to the city of Avignon; one is called the canal of Crillon, another the canal of Real, and the third the canal of Boisgelin.

There is another canal cut out of the above canal, near to Eyguieres, into the great lake Berre, near the village of Istres, and which passes by the village of Salon.

There is also another canal out of the other side of the said lake to the village of Paillassent; these two canals, being into and out of the same lake, are called the canal of little Crapone.

These canals are in the southern part of France. I shall now enumerate those in the northern parts of the country; and first begin with the canal from Dunkirk to Furnes, called the canal of Dunkirk.

There is another canal from Dunkirk to Bergues, called by the same name.

There is another canal from Bergues to Furnes, called the canal of Furnes.

There is also another canal from Furnes to Nieuport, called the canal of Nieuport.

Another canal proceeds from Bergues, by the village of Colne, to St. Omers, and is called the canal of Bergue. This canal is continued from St. Omers into the river Lys, at the town of Aire, and is called the canal of Aire.

Another canal, cut in the year 1681, begins just above the town of Calais, and is carried across the country into a river near the town of Audriue, which runs down to Gravelines. These canals intersect the country, and are not only useful for navigation, but for draining that low country, which otherwise would be a bog, and covered with water, whereas by this means it is rendered, perhaps, one of the most fruitful countries in Europe.

A canal communication by locks is made between the towns of Lens, Lille, Douay, and the rivers upper and lower Deule, the Scarpe and the Scheld. From the city of Lille the canal takes a course near La Bisse and Lens to Douay, and is called the canal of Lille and Douay; from thence it returns back, and goes out of the Scarpe, passes near Marchienne, and joins the Scarpe again at the town of St. Amand, from which it returns back, with a very acute angle, three parts of the way to Douay, and parallel on the other side of the Scarpe, and is called the canal of Tritaire.

Many other parts of the kingdom have canals of communication. Three canals are cut out of the small river Bonne, near to the city of Grenoble; and another is cut lower down that river. It goes out of the river Drac, and is called the canal of Merbeys.

A small canal is cut out of the river Pau, near to the city of Pau; it is called the canal of Lester.

Another canal is cut out of the river Adour, near the village Barcelonne, which goes to the town of Adour.

There is a canal cut out of the bay of Rochelle, to the town of Lucon, called the canal of Lucon; and near the same place the course of a canal is marked out from the mouth of the river Saigre into the river Claine, near to the city of Poitiers. This, when finished, is to be called the canal of Poitou.

A canal, called the canal of Monsieur, is cut out of the Loire at Chalonne, and passes by Layon Thouarce to Martigne. Another canal is cut out of the fork of that river and Mayenne, near the town of Angiers, and proceeds to the town of Auchion.

A short canal is cut out of the bay opposite to the island of Bellisle, to the town of Vannes.

These

These canals, already finished, measure in length eight hundred and fifty-eight thousand toises, or one thousand nine hundred and thirty-nine English miles.

Besides the before-mentioned canals, which are finished, there are a great number of others projected, to find employment for the soldiery. I shall here enumerate some of them which have come within my own observation.

From the city of Valenciennes a canal is marked out, to pass by Quesnoy into the river Sambre, near to the town of Berlarumont. It is to be called the canal of Quesnoy.

From the village of Hennecourt a canal is marked out near Cambray, on the river Scheld, to join that canal which is finished, and which I have before mentioned, at St. Quentin, called the canal of Picardy. This canal is intended to go from St. Quentin to Sissy on the Oise, and is to be called the canal of Souterin. This canal, when finished, will join the Scheld with the Oise.

Another canal is marked out higher up the Oise, at the town of Guire, to join it to the Sambre at Fenny (or Ferney) near to the town of Landrecy.

Another canal is marked out from the Oise below the canal of Picardy, at Chauny, to go to Laon, and return with a sharp angle into the river Vette at Anify. It is to be called the canal of Laon.

From the river Somme, near the city of Amiens, a canal is marked out to pass by Corbie, Bray, and Peronne, to Ham, and join the canal of Picardy near the last town, which consequently will join the Somme with the Oise.

Another canal is marked out from the Oise at the village of Criel,
below

below Compiègne, to the town of Bevois, to be called the canal of Bevois.

Four canals are marked out near the city of Paris; one from the Oise, at the Isle Adam, to cut into an elbow of the Seine at St. Dennis, and then out of the river straight to Paris: another canal is marked out from the Seine across the country into the river Mame at Gournay: a third canal is marked out from an elbow of the Seine, above St. Dennis, to Paris; and a fourth canal is marked out from Versailles into the Seine, at the elbow at Sevres, near to Paris.

A canal is marked out to join the Meuse at the village of Pagny, with the Moselle, at the town of Toul.

A canal is marked out at Cofney on the Loire, to join the Yonne at the village of Swai, to go down that river to the Seine, and to be called the canal of Cofney.

A canal is marked out from the little river Love, at the village of Lignon, to join the canal of Burgundy at Dijon.

A canal is marked out from the Rhone at Geiffial, to fall into the lake of Geneva at Verfoix, to be called the canal of Verfoix.

A very large and long canal is marked out from the bay, near to the city of Marseilles, to pass by Gardane, and near the city of Aix, to the villages Foutouble and Lambeste, and return with an acute angle into the river Durance, near to the fork where the river Verdon goes out of that river: this canal is to be called the canal of Provence. A small canal is already finished, cut out of the Durance to the small town of Pertuis: it is called the canal of Durance.

A canal is marked out of the river Tet, in the same bay, and is intended

tended to pass by the city of Perpignan to the village of Millas ; and another is marked out from the city of Perpignan, into the lake Nazaire, at the village of Salcos.

If we now pass to the other side of the kingdom, we shall find a canal marked out from the Garonne, at the village of Instres, into the river Leyre at Bellin, which is to be called the canal of Autre.

Another canal is marked out from the Garonne, at the city of Bourdeaux, into a lake called Bassin de Arcachon, and to proceed from one corner of it, at the village of La Tête de Bouc, into the sea : it is to be called the canal of Bourdeaux.

A canal is marked out from the mouth of the river Saigre, near to the city of Rochelle, into the river Clain, near the city of Poitiers : it is to be called the canal of Poitou.

A canal is marked out from the Loire at the town of Saumur to Moncontour, to be called the canal de Desechement.

Several other canals are marked out and projected, too tedious and perhaps uninteresting to mention : we may however observe, from the enumeration already given, with what care and assiduity the French nation are improving every internal part of the kingdom, by canals cut from one river into another, and some even into the Mediterranean, and the ocean.

The lengths of these different canals, being added together, make four hundred and fifty thousand toises, or five hundred and forty-five English miles ; an amazing extent of country to improve by inland navigation, which they are sanguine enough to hope will be entirely completed before the year 1800.

I cannot

I cannot omit to mention, before I leave the subject of France, another magnificent work of Louis XIV. as if his grand canal were not sufficient to immortalize his name: I mean the famous aqueduct he built near Maintenon, for carrying the river Eure to Versailles, from one mountain to another, across a valley, which contains two hundred and forty arcades, and is seven thousand toises, or nearly eight English miles and a half long, and raised to such an elevation, that it is certainly altogether the greatest piece of modern architecture of the kind in the world.

S P A I N.

SPAIN is a vast body without a substance, which has greater riches than strength. The mines of Mexico and Potosi furnish that kingdom with means to purchase every thing except liberty; but bigotry and superstition, together with the Inquisition, prevent the subjects of other countries from emigrating to it, and population is far from being encouraged. The pride of the Spaniards will not permit them to cultivate their lands, which are some of the finest in Europe, nor to apply themselves to commerce; and notwithstanding all their riches their country is barren, and the body of the people poor.

History informs us, that it has frequently been proposed in Spain, to cut a canal through the isthmus of Darien, from Panama to Nombre de Dios, to effect a ready communication between the Atlantic and South seas, and thus open a straight passage to China and the East Indies: but the project appears to have been considered as chimerical, and treated with ridicule. It cannot indeed be supposed, that the Spaniards would neglect to furnish their own country with canals, of which it is really in want, and yet be anxious to improve, by means of such works, a colony, and that a barren mountainous country, at three thousand miles distance.

Spain,

Spain, however, has attempted something in the way of canals, to improve the internal part of the country ; but very much is wanted to complete them, and to render them useful and profitable; though in any other country in Europe (Turkey and Portugal excepted) similar undertakings would very soon have been brought to perfection.

In 1785 the famous canal of Arragon began to justify the hopes which had been entertained of it; since the reign of Charles V. some small vessels from Tudela arrived at Saragossa, where they were received with the most lively demonstrations of joy.

Don Ramon Pignatelli did not think he derogated from the high dignity of an ecclesiastic, nor from that of his illustrious birth, in devoting his studies to the service of his country : he presides over this undertaking ; which, when accomplished, will open a new conveyance to the productions of Arragon, one of the provinces of Spain the most favoured by nature, and yet one of the least productive relatively to its extent. Two canals, that of Tauste, and the Imperial Canal, both of which begin at Navarre, and have the same depth of water, run in various windings through Arragon, and by turns recede from or approach the river Ebro, till they at length fall into it. These streams are the sources of industry to all the districts through which they flow, and render their fields fertile by their fructifying waters.

The country or province of Arragon is already planted with thousands of olive and other trees : the cities and towns, which formerly were condemned to drought and scarcity, are now supplied with fish and water from these canals.

The rivers, which, from the north of Navarre and Arragon, formerly emptied their waters into the Ebro, will contribute to the flourishing condition of the countries they have hitherto uselessly watered, as soon as the Ebro can receive the merchandise they bring. This undertaking

has been effected by labours, that deserve no less admiration than that excited by the wonders of the canal of Languedoc. Besides the dykes, banks, and sluices, with the larger and smaller bridges, which the two canals in their course rendered necessary, there has been constructed in the valley of Riojalon, an aqueduct seven hundred and ten fathoms in length, and seventeen feet thick at the base, in which the little river or canal runs.

Another canal, which makes but very slow progress, is cut out of the little river Pisuerga, which runs from north to south; the waters of which it was intended should be made to supply the canal of Castile, projected and begun in the last reign. This project was afterwards almost abandoned, to the great prejudice of Old Castile, which only waits for such an opportunity for the sale and increase of its productions. The canal was to begin at Segovia, and follow the course of the river Eresma, which falls into the Duero, to be continued as far north as Reynosa, receiving from the little rivers in its passage the tribute of their waters. Reynosa is but twenty leagues from St. Ander; a sea port where all the merchandise exported from Old Castile is shipped: a road (which will be destroyed before the canal is finished) has been made to facilitate a communication by land.

Spain owes to the sovereigns of the house of Bourbon the few roads and canals she possesses. We have already mentioned the canal of Aragon, and also that of Castile: the canal of Murcia next claims our attention, the completion of which has been found impracticable: the subscribers, instead of the profits which their avidity grasped at, must content themselves with the interest that the king pays them.

In the year 1784, the minister adopted a project much more brilliant and useful than that which he was obliged to abandon. A canal was planned, which, beginning at the foot of the mountains of Guadarrama, near the Escorial, should proceed to join the Tagus, afterwards the Guadiana,

Guadiana, and terminate at the Guadalquivir above Anduxar; and which consequently will give new life and activity to the interior parts of Spain, the least populous and most barren parts of the kingdom. A Frenchman of abilities, named Le Maur, gave in the plan, and was preparing to carry it into execution, but died soon afterwards. The impulse, however, was given, the money subscribed, and the estimate made, and the undertaking is continued by the sons of Le Maur, who inherit from their father all his plans, and a portion of his talents.

In May 1785, the bank made a proposal, the admission of which will find new employment to its funds, and give security to encouragement: this was to undertake the completion of the canal above mentioned, which begins at the foot of the mountains of Guadarrama. The bank offered to make the necessary advances for this great undertaking, upon the same conditions on which it received the contract for victualling and clothing the troops; and the proposal was accepted by government, who immediately employed Le Maur as before-mentioned; nor did the unexpected death of that able engineer suspend the work, it being carried on by his sons.

Another canal was begun under the administration of M. De Grimaldi, to join the river Manzanares at the river Tagus: scarcely were three leagues of it finished, when want of capital and industry suspended the works: the only advantage derived from it is, the produce of a few mills; and this is absorbed in the repairs of bridges and sluices, and the salaries of the persons employed. But the activity now given to all the branches of administration will soon have its effect on the canal of Manzanares: the mills upon it are already useful to the undertakings of the bank charged with victualling the army; and the canal itself will, in a short time, become a part of that, which, as has been already observed, is to cross all the interior parts of Spain.

In 1785, General O'Reilly, governor of Cadiz, employed M. Bour-

nial, whom he sent for from France, to bring fresh water to Cadiz, from springs at the distance of eleven leagues; but on General O'Reilly's disgrace the scheme was abandoned, although M. Bournial had surveyed and taken the levels, and finished the plans; and, to engage the nation to carry it on, had, on opening the ground, found and traced the remains of an old canal or aqueduct, without doubt dug by the Romans for the same purpose.

The internal parts of Spain are as capable as, if not more so than, any country in Europe of receiving the improvements of inland navigation; and there is no country in the world to which they are more necessary. The great rivers Ebro, Guadalquivir, Guadiana, Tagus, Duero, and Minho, rise in the middle of the kingdom, and run into the Ocean and Mediterranean: and there are besides many others of lesser note, from which navigable canals might be made to intersect the interior parts of the country, at a very reasonable expence. The profit of such undertakings would be immense, for it will scarcely be believed, that even in this enlightened age, the Spaniards carry the products of the interior parts of the country, which chiefly consist of wine and oil, in large leather bottles, on the backs of mules and asses, from one province to another. Grain also is conveyed in like manner to different parts of the country, which grow none, although the climate is perhaps the finest in the world,

An Englishman would scarcely be able to contain his indignation to see the gifts of Providence so abused, when very little assistance from art is required, to complete what nature has so abundantly lavished. The author of this work was in treaty with Prince Masserano, when he was ambassador at the British court, to go to Spain with a number of workmen from England, if they could have obtained permission from government, to make common sewers throughout the city of Madrid, and pave it after the manner of London, which it is in great want of; and
also

also to survey the country, to improve it with canals : but the war with Spain very soon after succeeding, the Spaniards having joined the Americans, and acknowledged their independance just before application was intended to be made for the permission of the English government; the scheme was rendered abortive.

The kingdom of Spain, according to Ustariz, contains about seven millions and a half of inhabitants, and would support twice that number were it properly cultivated, its manufactures encouraged, and its mines worked. It contained, in the times of the Goths and Moors, between twenty and thirty millions of people. Inconsiderable too as the number of the inhabitants is, yet they are also very poor, though they live in a land capable of supporting many millions more in plenty, and which, besides its natural advantages, has prodigious sums of money poured into it from America.

Savala, in his *Treatise del Comercio de las Indas*, computes, that from the year 1492, when America was discovered, to 1731, above six thousand millions of pieces of eight in registered gold and silver have been imported into Spain, exclusive of far greater sums unregistered. But as these remarks may appear somewhat foreign to my subject, I shall proceed, according to my plan, to the canals of England.

C H A P. VII.

Of the Canals of England.—Canal of Caerdyke.—The New River.—The Duke of Bridgewater's Canal, being the first navigable Canal made in England.—Difficulties surmounted in the Execution of this astonishing Work.—Account of the Aqueduct by which the Canal is carried over the River Irwell, near Barton Bridge.—Extracts of the Acts, enabling the Duke to cut his Canal.—Utility of this Canal.—Particulars of the Life of the ingenious Mr. Brindley, the Engineer employed by his Grace in this great Work.—Description of the subterraneous Passage into, and the Inside of his Grace's Coal Mine at Worsley Mill.—Account of the Surveys for an intended Inland Navigation from Liverpool to Hull.

ENGLAND, in which all the arts and sciences, commerce, and agriculture especially, flourish, is an island containing numerous rivers, rendered navigable by art, where they are not so by nature. The rivers Thames, Trent, Severn, and Mersey, extend far into the country, and almost divide the island into four parts: yet, though four of the principal ports of the kingdom, viz. London, Bristol, Liverpool, and Hull, are commodiously situated on these great rivers, and incessantly crowded with innumerable vessels, laden with the richest productions of the different countries of the world, none of these great commercial ports had, for a long time, any other communication with each other, than by a tedious and circuitous navigation, or a tiresome and expensive land-carriage: and though we had, so near us as Holland and France, several examples of canals for inland navigation, executed and attended with the greatest advantages, because by them a sale was procured for a variety of productions

productions of the internal parts of those countries, which were before useless, or only consumed near the place of their growth ; yet neither government, nor any public-spirited individual, attempted any works of that nature in England.

To the insular situation of Great Britain, and its numerous large and navigable rivers, we may no doubt justly attribute the long neglect of canal navigations in this country. A private undertaking of that kind was at length begun, by a noble duke, during the continuance of an expensive but glorious war, in which conquest crowned in the most signal manner almost every effort of the British arms.

Peace succeeding, a full tide of commerce, and its concomitant, wealth, poured into England from every quarter of the world ; and new sources of trade and riches being opened, excited a general emulation among our manufacturers to rival and surpass, if possible, those of other countries. How far they have succeeded, and are daily succeeding, is not for me to determine.

The success of the noble individual above-mentioned, who planned and began the first canal for inland navigation in this country, by drawing a mine of wealth from the bowels of a mountain, which had been hitherto totally useless, and of no value, awakened a general ardour for similar improvements among the land owners, farmers, merchants, and manufacturers of the kingdom ; and although there was neither a Louis XIV. nor a Colbert to encourage, there wanted not engineers equal to Riquet ; and England, though late, began to rouse from her lethargic slumber, and pour forth the riches which she possessed in her inland provinces ; to effect which her navigable rivers alone, however numerous and large, were found to be inadequate.

In treating of the canals of England, *Caerdyke*, if it may be called a canal, ought perhaps first to be mentioned, as it is the most ancient ; but

whether

whether it was intended for the purposes of inland navigation, it is impossible that I should determine, different authors having assigned to it different uses: but as it is cut from the river Nyne, a little below Peterborough, into the river Witham, three miles below Lincoln, there is great reason to suppose that it was intended to join those two rivers. It is probably a work of the Romans, and was forty miles in length, though it is now almost filled up, and must have been very deep. Some authors, however, suppose it to have been cut by the Danes. Moreton will have it to have been made under the Emperor Domitian; and urns and medals have been dug up near it, which seem to confirm this opinion.

The canal for supplying London with water, commonly called the *New River*, was projected and begun by Mr. (afterwards Sir Hugh) Middleton, in the year 1608, and finished in five years. This canal begins near Ware in Hertfordshire, and takes a course of sixty miles before it reaches the grand cistern at Islington, which supplies the several pipes that convey the water to the city and parts adjacent. In some places it is thirty feet deep; and near Hornsey it was formerly conveyed over a valley, between two hills, by means of a wooden trough supported by wooden arches, and about twenty-three feet in height; but of late years the course has been changed, and the river embanked. In other places, meandering round hillocks and rising grounds, it is confined on one side by the solid hill, and on the other by large thick banks, piled, or large mounds.

The different rivers which have been made navigable by art above the tide-ways, do not come within my plan: the first canal, therefore, which claims attention as being the first public work of the kind executed in England, although completed at the expence of a private individual, is that cut by his Grace the Duke of Bridgewater, in whose praise it would be unpardonable to be silent, who, at an age too often spent in dissipation by our young nobility, applied his attention to use-
ful

ful objects, and had the spirit to hazard so great a part of his fortune in an undertaking worthy the pursuit of a prince, which, however, has ultimately proved highly profitable to himself, and beneficial to his country. When the influence of exalted rank and large possessions is thus nobly and usefully exerted, they confer additional lustre on the possessors, who then justly merit being ranked among the first citizens of the community.

His grace has the honour, as well as pleasure, of having first introduced inland navigation into this kingdom; the utility of which is so sensibly known and felt, that it is at length, to the profit and happiness of this country, encouraged by the nobility and land owners in many of the interior parts of the country. It would also be unpardonable to withhold the praise so justly due to the penetration of this illustrious nobleman, for having called forth the hidden talents of a Brindley; talents, which, but for his grace, would have been utterly lost to his country.

In 1758 and 1759, his grace the duke of Bridgewater, after obtaining two acts of parliament for that purpose, projected, began, and executed, under the direction of his engineer, Mr. Brindley, his first canal, which was designed for conveying coals from a mine (or more properly a mountain) on his grace's estate to Manchester, but has since been applied to many other useful purposes of inland navigation. This canal begins at a place called Worsley Mill, about seven computed miles from Manchester, where the duke has cut a basin capable of holding, not only all his boats, but a great body of water which serves as a reservoir, or head of his navigation. The canal runs through a hill, by a subterraneous passage, big enough for the admission of long flat-bottomed boats, which are towed by hand-rails on each side, near three quarters of a mile under ground to the coal-works. There the passage divides into two channels; one of which goes five hundred yards to the right, and the other as many yards to the left, and both may be continued at pleasure.

The passage is in some places cut through the solid rock, and in others arched over with brick. Air funnels, some of which are thirty-seven yards perpendicular, are cut at certain distances through the rock to the top of the hill. The arch at the entrance is about six feet wide, and about five feet high above the surface of the water. It widens within, so that in some places the boats may pass each other; and at the pit is ten feet wide. The coals are brought to this passage or canal in little low waggons, that hold nearly a ton each; and as the work is on the descent, are easily pushed or pulled along, by a man on a railed way, to a stage over the canal, and then shot into one of the boats, each of which holds seven or eight tons. They then, by means of the rails, are drawn out by one man to the basin at the mouth (a boy of seventeen years of age has worked twenty-one of these boats at a time, which at seven tons each, the lowest quantity is one hundred forty-seven tons brought out of the pit to the basin at the entrance); then five or six of them are linked together, and drawn along the canal by a single horse, or two mules, on the banks or towing-paths: it is there broad enough for the barges to pass or go abreast; and in the course of nine miles (a circuit of two miles being made in seeking a level) the canal reaches Manchester. The canal is raised over public roads by means of arches; and where it is too low for a carriage to go under, the road is lowered with a gentle descent, and ascends on the other side: it is thus carried over the navigable river Irwell, and nearly forty feet above it; so that large vessels in full sail pass under the canal as under a large lofty bridge, whilst the duke's barges are at the same time passing over them.

It may be proper here particularly to describe the noble aqueduct which carries this canal over the river Irwell. This stupendous work was begun at a place called Worley Mill, about seven miles from Manchester, where, at the foot of a large mountain, which proves to be composed of coal, the duke has cut a basin capable of containing all his boats, and a great body of water, which serves as a reservoir or head to his navigation. At Barton-bridge, three miles from the basin, begins

begins this aqueduct, which, for upwards of two hundred yards, conveys the canal across a valley; and also above forty feet above the navigable river Irwell: there are also stops at each end, that may occasionally be drawn up, and let off the whole body of water, which is easily done by drawing a plug, and discharging the water into the Irwell, through a wooden tube. There are many of these stops or flood-gates so constructed, that should any of the banks give way, and thereby occasion a current, they will rise by that motion, and prevent the damage that would otherwise happen by the waters overflowing the country.

This bridge unites the Lancashire and Cheshire parts of the duke's navigation; it is carried over the meadows on each side the river Mersey, and quite across Sale moor, at incredible labour and expence. Mr. Brindley caused trenches first to be made, and then placed deal balks in an upright position, from thirty to thirty-six feet long, backing and supporting them on the outside with other balks laid lengthways, and in rows, and screwed fast together, driving in some thousands of oak piles of different lengths between them; and on the front side he threw the clay and earth, and rammed them well together to form his navigable canal. After thus finishing forty yards, he removed the balks and proceeded again as before, where it was designed to continue the canal.

The bridge for the aqueduct over the river Irwell, is built all of stone of great strength and thickness. Every stone in the faces has five square beds and sides, well jointed and cramped with iron cramps. There are three arches over the river Irwell, which, with their piers, are all of hewn stone, of the largest dimensions, and cramped in the same manner as the others. The centre arch is sixty-three feet wide, and thirty-eight feet high above the water, and will admit the largest barges, which navigate the Irwell, to go through with mast and sails standing. See the annexed plate.

At Stretford, three miles from hence, was the caisson, forty yards

long by thirty-two broad. Open bottomed boats were employed to carry and discharge loads of earth, and thereby raise the ground where the level required it: these were employed in the caissons, as the ground they passed over lay sixteen or eighteen feet below the surface of the canal: they carried about eighteen tons, which, with great ease, was shot out in an instant where wanted.

At Combroke, three miles further, is a circular wear to raise the water of the canal to its proper height: the surplus flows over the nave of a circle in the middle of the wear, built of stone, into a well, and by a subterraneous tunnel is conveyed to its usual channel: there is also a machine to wash the slack, which is worked by water.

In order to feed that end of the navigation which is near Manchester, Mr. Brindley raised, and as it were swallowed up, the river Medlock, by a large beautiful wear, composed of six segments of a circle, built of square stone, bedded in terras, and every stone cramped with iron: the whole circumference is three hundred and sixty-six yards, with a circular nave of stone in the middle. The water, when at a proper height to supply the navigation, flows over the nave, and down the well as at Combroke; but in order to keep the bed dry during the time the workmen were building this wear, he turned off the greater part of the water by a cut through the rock, and invented an engine, which he called a spoon, and which he worked, at the end of a lever, by a horse. When this spoon dips into the water, a kind of flap door, made of leather, is pressed open, and admits the water till full; and on being weighed up the pressure of the water within closes the door, and, as the lever rises, it runs off into a channel cut at the end of the spoon handle.

From the wharf at this place, the poor of Manchester fetch great quantities of coals in wheel-barrows, at three-pence half-penny a hundred weight of seven score, which is not one half the price which was before paid for that necessary article. But Mr. Brindley, to remove the inconvenience

inconvenience of carrying them up Castle-hill, has driven up a large tunnel through the centre of this hill, into which the barges are introduced ; and by a crane, which is worked by a box water-wheel of thirty feet diameter, and four feet four inches wide, they are landed close to the town. This branch of the canal to Manchester is very near ten miles in length, and has been executed, on an average, at the expence of a thousand guineas a mile.

At Langford-bridge, the canal turns away to the right, and crossing the river Mersey, passes near Altringham, Dunham, Grapenhall, and Haulton, into the tide-way of the river Mersey at Runcom Gap, where his grace's barges can come into his canal from Liverpool at low water.

The ingenuity and contrivance displayed through the whole work was wonderful. The smiths' forges, the carpenters' and masons' workshops, were covered barges, which floated on the canal, and followed the work from place to place ; by which means there was very little or no hindrance of business from accidents ; and as the duke had all his materials in his possession, timber, stone, and lime for mortar, and coals from his own estates, and ready at hand, he has been at little expence except labour. It is also to be observed, that the duke has made the refuse of one work serve for the construction of another. Thus the stones which were dug up to form the basin for the boats at the foot of the mountain, as well as those taken out of the rock to make the subterraneous passage, were hewn into different forms, shapes, and dimensions, to build bridges over the rivers, brooks, or highways, or arches to support the aqueduct. The clay, gravel, and other earths, taken up to preserve the level at one place, are carried down the canal to raise the land in another, or reserved to make bricks for other uses.

Here grandeur, elegance, and economy, are happily united. At first view it would seem, that the work was solely intended to excite astonishment. But, on a closer inspection, there is to be found nothing but

but what is proper and necessary, and the whole has been finished at an expence no ways adequate to the undertaking: in short, the work is truly admirable, and will be a standing monument of the good taste, public spirit, and economy of the duke of Bridgewater, to the end of time.

Before the duke began his canal, the price of water carriage by the old navigation on the rivers Mersey and Irwell, from Liverpool to Manchester, was twelve shillings the ton, and from Warrington to Manchester, ten shillings the ton. Land carriage was forty shillings the ton, and not less than two thousand tons were yearly carried on an average. Coals at Manchester were retailed to the poor at seven-pence per hundred weight, and often dearer. The duke, by his navigation from Liverpool to Manchester, carries for only six shillings a ton, and in as short a time, and with as certain delivery as if by land carriage, because he is able, at the lowest neap tides, to come into or go out of his canal at Runcom Gap to Liverpool, which he could not do if he had gone in at the Hempstones, as was at first intended; consequently one half is saved to the public of the old water carriage, and almost six parts in seven of the land carriage. Coals also are delivered at Manchester, seven score to the hundred weight, for three-pence half-penny.

I cannot give a better description of the duke's canal, and his intentions to serve the public, than by a short extract of the acts of parliament which he obtained for that purpose, adding a few observations, as I proceed, by way of explanation.

In the session of parliament of the years 1758 and 1759, his grace the duke of Bridgewater obtained an act, for enabling him to cut a navigable canal from Worsley to Salford, near Manchester, and to carry the same to or near Hollin Ferry, in the county of Lancaster.

Soon after the passing of this act his grace began his works, and
made

made a navigable canal from Worsley Mill to the public highway leading from Manchester to Warrington; but it being then discovered, that the navigation would be more beneficial both to his grace and the public, if carried over the river Irwell, near Barton-bridge to Manchester, his grace applied again to parliament to vary the course of his canal accordingly, and to extend a side-branch to Longford-bridge, in the township of Stretford, and he obtained an act for that purpose.

The making a navigable canal over the river Irwell, and filling up the great hollow ground on the north side of this river, was looked upon as a very arduous undertaking, and, by most persons who viewed the chafms, thought to be impracticable: but his grace being well supplied with materials from his own estate, has completed this as well as the other difficult parts of his great undertaking.

By the first act, a rate or duty not exceeding two shillings and sixpence per ton was granted to the duke as a recompense, for the charges of making and completing his navigation; and the second act varies the course of the canal, and extends it, but makes no alteration with respect to tonnage.

The duke, upon a farther survey, and taking levels, found it practicable to extend his canal from Longford-bridge, by Dunham, to fall into the river Mersey, at or near a place called the Hempstones, below Bank-quay, so as to bring vessels into his canal at the lowest neap tides; and having obtained a third act for that purpose, undertakes this at his own expence, without any addition or increase of tonnage.

“ If navigations are advantageous to a country, that advantage must
“ increase in proportion to their extent, and the intercourse and con-
“ nections with the parts with which they communicate; and allowing
“ this to be a fact, there certainly cannot be a more interesting con-
“ sideration, than the facilitating the conveyance of goods and mer-
“ chandise

“ chandise between the great trading towns of Manchester and Liverpool.”

The first act recites in the preamble, that the persons named in the act 10 Geo. II. intituled “ An act for making navigable the river or brook, called Worley Brook, from Worley Mill, in the township of Worley, in the county palatine of Lancaster, to the river Irwell, in the said county,” have hitherto neglected to carry the said act into execution, &c. and that a cut or canal may be made from a certain place in the township of Salford, &c. near Manchester, in the said county of Lancaster, to or near Worley Mill aforesaid, and Middlewood, in the manor of Worley, and to or near Hollin Ferry, in the same county, and supplied with water from the said Worley Brook, and other brooks and places near, &c. &c. &c. sufficient for floating or carrying of boats and other vessels of considerable burthen, by which the conveyance of coals, timber, stone, manure, goods, wares, and merchandises, to and from Manchester and Salford, &c. &c. will be greatly facilitated, &c. &c. The act impowers his grace the duke of Bridgewater, his heirs, &c. &c. to make and maintain the said cut or canal, at his or their own proper costs and charges, to enter lands, dig, and remove obstructions, and to make towing-paths on the sides of his canal, gutters, and water-courses, locks, sluices, &c. &c. weighing-beams, bridges, arches, &c. and set up posts, rails, &c. first making satisfaction to the owners of or persons interested in such lands or grounds, &c. &c. No water to be taken out of the river Irwell into his cut or canal. Power is given to survey and set out lands, and all persons impowered to convey such lands to the duke. But the lands so to be set out shall not exceed sixteen yards in breadth, except, &c. &c. No wharfs to be made between Salford and Barton-bridge, without the consent of the owners of the lands. Commissioners are named to determine differences, &c. between the duke and the proprietors of lands, &c. &c. to settle recompenses. If parties will not submit to their determination (i. e. of any seven of them), refuse to accept the purchase money, &c. or to treat, or shall not agree,

agree, juries may be impannelled to assess the purchase moneys, &c. Penalties are 20l. for the sheriff or coroner, 5l. for every jurymen and person summoned who shall make default, to be levied by distress and sale of goods. The commissioners may settle the proportions of the moneys to be paid to the several persons interested, with an exception. Determinations, verdicts, and judgments, to be kept by the clerk of the peace; and if the sum given by the jury be greater than that settled by the commissioners, then the duke to pay the expence of such jury. Upon the payment of the sums assessed, the lands, &c. to vest in the duke; and in default of payment, the sums assessed to be recovered with full costs of suit by action of debt, against the said duke, his heirs, assigns, &c. &c. wherein no essoin, protection, privilege, wager of law, or more than one imparlance shall be allowed. If costs and damages are not paid in three months, to be levied on the duke's coals, boats, &c. The works done in pursuance of this act not to be subject to the sewer laws. The coals from the duke's mines not to be sold for more than four-pence per hundred weight at Manchester or Salford. Qualification for a commissioner or jurymen 50l. per ann. freehold, or 1000l. personal estate after payment of just debts. The duke to fence in the towing-paths from the adjoining lands, erect bridges, &c. or on neglect the commissioners to do it, and levy the charges. Houses not to be taken down, or timber cut, &c. except such as are ascertained for the purposes of the act. The next clauses relate to the election of the commissioners in the room of such as die or refuse to act, and the regulation of their meetings. Purchase moneys for lands, &c. in strict settlement to be placed out in government's funds, &c. &c. Felony for any person to destroy or damage the works. The writings in pursuance of this act to be exempted from the stamp duties, and no proceeding taken in pursuance thereof to be quashed for want of form. The navigation to be free upon paying the tolls. The duke, &c. empowered to fix the tonnage rates, which are not to exceed two shillings and six-pence per ton; and rates neglected to be paid may be sued for or levied, and a farther allowance is to be made for goods remaining on

the wharfs above twenty-four hours. The owners of lands, &c. to have free liberty to carry dung by the canal to their lands. Rights of lords of manors saved; and owners of vessels to be responsible for their servants. Vessels lying so as to obstruct the navigation to be removed, and sunk vessels to be weighed up. The next clauses direct the manner of collecting and ascertaining the tonnage rates, the management upon differences, &c. Any person throwing ballast into the canal, to forfeit twenty shillings. Persons giving false evidence in the premises, to be prosecuted and punished as persons guilty of wilful and corrupt perjury. The proceedings of the commissioners to be registered, and a clerk appointed. The next clause directs the recovery and application of penalties. Persons aggrieved may appeal to the quarter sessions for the county of Lancaster. The commissioners may act as justices. The former act mentioned in the preamble is repealed: actions brought on this act must be commenced within six calendar months after the offence: the party convicted to pay treble costs, and the act to be deemed a public act.

The second act enables his grace, at his own expence, to make a navigable cut or canal from or near Worsley Mill, over the river Irwell, to the town of Manchester, and to, or near, Longford-bridge, in the township of Stretford, in Lancashire. The powers of the former act are extended to this, but the breadth of the canal and towing-paths not to be limited. His grace is impowered to make arches over the river Irwell, at Barton-bridge: but the navigation of the said river is not to be obstructed, provided the proprietors of the navigation of the said river do not open locks for longer time than is necessary. The canal, arches, &c. to be the property of the duke. The duke's works not to be carried nearer the buildings of Mr. Lloyd, of Hulme near Manchester, than thirty yards, &c. Nor is he to erect wharfs, &c. in Quay-street, Manchester, or upon Mr. Byrom's lands, except as excepted. Tolls to be paid on Crosford-bridge road, so as the same does not extend to a double charge; and coals which have been navigated on the canal,

shall pay at the turnpikes only one moiety of their tolls or duties, granted by the act 24 Geo. II. at such turnpikes as are erected by virtue of that act. The trustees of that road may compound with the duke for the carriage of coals thereon. The duke to maintain the bridges over the canal, where it crosses the turnpike road. The lords of manors rights are reserved, and the act declared a public act.

The third act enables the duke to make a navigable cut or canal from Longford-bridge, in the township of Stretford, in Lancashire, to the river Mersey, at a place called the Hempstones, in the township of Halton, in the county of Chester. The two former acts are recited; and as the canal is capable of being extended, &c. (as above) the duke is empowered to extend it at his own proper costs and charges, to remove obstructions, and to make arches and other works on the river Mersey, as also bridges, roads, &c. Commissioners are named, their power settled, and their meetings regulated as in the first act. Flour, &c. which has paid toll before grinding, not to pay it again. Persons evading the payment of the toll forfeit forty shillings for every offence, to be recovered as by the first act. No corn-mills to be erected on the canal or towing-paths. The duke not to divert certain water-courses or streams of water therein mentioned; and a recompense to be made for using ancient streams, which communicated with the rivers Mersey and Irwell. The next clauses direct the application of forfeitures, and give the same power to the justices of Cheshire, as were by the first act given to those of Lancashire. The tonnage duty to be taken not to exceed two shillings and six-pence per ton, and the same may be paid for certain kinds of commodities mentioned; and no higher duty to be taken upon the navigation than is authorised by the former acts. No toll to be taken for manure, or for stones to repair the highways. The duke to make weirs before the boats pass through the locks. The next clause directs, that drains, &c. shall be made into the canal to convey the water from the lands adjoining, and in what manner they shall be maintained. The next impowers bodies politic, &c. to sell or con-

vey in exchange lands for the use of the navigation. Trees not to be planted, nor buildings erected, on towing-paths, except as excepted, without consent. The next clause impowers owners of lands near the navigation to make wharfs, quays, &c. on their own lands. The next limits the breadth of the canal and towing-paths, as in the first act. No more than six shillings per ton to be taken for the carriage of goods between Manchester and Liverpool. Lands to revert to the original proprietors, if the navigation is not made through them in ten years, or if made and discontinued five years. The powers of the former act extended to this. The works not to be carried through Lord Stamford's park without his consent, nor nearer the house of the Rev. Mr. Halstead, in Lym, than fifty yards. In an action in any court on this act, no essoign, protection, &c. &c. nor more than one imparlance shall be allowed, and the act to be deemed a public act.

By the above abstracts, it will appear how cautiously the legislature guarded against the infringements of public or private rights, or trespassing upon private property. The acts are explicit, and full provision is made against any difference that could at first, or may hereafter arise between the duke and other persons concerned.

The above navigation is more than twenty-nine miles in length: it falls ninety-five feet, and was finished in five years. The utility and profits of it were soon perceived by a discerning and trading people, and a number of applications immediately made to Parliament for different acts, as was expected, to join the four great trading cities, London, Bristol, Liverpool, and Hull, by an inland navigation, with branches to different manufacturing towns, as I shall more particularly relate hereafter.

I cannot give a true character of the duke of Bridgewater, and that of his celebrated engineer, nor set forth the great utility of their wonderful undertaking in more lively colours, than by giving a literal extract from a treatise on that subject, written by a gentleman well known for his
great

great abilities as a statesman, as well as his great knowledge of the mercantile world and landed interest. And if I should be deemed prolix, I hope I shall be excused, from my desire to please and be useful to my readers; for such a theme can scarcely ever be exhausted, nor ought such a stupendous work to be treated merely as a common occurrence or undertaking.

This gentleman begins:—"Nor can I enough admire and commend
"that noble spirit and good sense, with which his grace the duke of
"Bridgewater has so lately proved to the world, that the advantages of
"an inland navigation are only to be obtained by carrying and cutting
"level canals of dead water from one town to another, which admit
"not, nor are subject to, one half of the inconveniences which the late
"method of making rivers navigable, by pounding up the water by
"large and very expensive locks, is of necessity exposed to from the
"force of the stream and floods. Nor can I help admiring the won-
"derful and great natural genius of Mr. James Brindley, who has
"planned the same, and perfected these canals, surmounting, with his
"own genius, and his grace's money and spirit, things that might have
"been thought by nine hundred out of a thousand people, almost insur-
"mountable difficulties. The breadth of these canals is about eight
"yards wide, and four feet deep; they are chiefly made in a straight
"line over a flat country. His grace's first attempt was in order to
"carry coals from his works to supply Manchester, and other towns in
"Cheshire and Lancashire: the last act of parliament enabled his grace
"to proceed to Altringham, in Cheshire, with which undertaking they
"are in great forwardness (1766). They have now completed about
"seventeen miles, at about seven hundred pounds a mile, exclusive of the
"expence of bridges, &c. The duke has built a very handsome bridge
"over the river Irwell, in order to convey his canal across: it is near
"fifty feet high, and five hundred yards long, with three large arches;
"the main arch being sixty-three feet wide. There is a road on each
"side the canal over the bridge for the horses to draw the vessels along;
"and

“ and indeed it is no unpleasant sight to see one vessel, near fifty feet
“ higher than another, sailing over the bridge at the same time that
“ another is sailing near fifty feet below. There is one place where
“ the canal goes over the highway from Manchester to Eccleston. But
“ what is most ingenious, I think, is the invention of flood-gates, that
“ are under water, and cross the canal : they lie almost horizontally, a
“ small matter inclining to each other, at a quarter of a mile distance, in
“ order that, if any part of the canal should break its banks, the draught of
“ the water rushing towards the breach may draw the two flood-gates
“ up ; by which means no more water will be lost out of the canal than is
“ contained between the two flood-gates ; and this, upon stopping the
“ breach, is easily restored, upon letting the gates down again, from the
“ adjacent part. In short, the principle upon which the whole is formed,
“ is a determined and fixed resolution to carry the level on through all
“ difficulties ; which plainly appears in that great and most amazing
“ bank of earth, which has been carried across Stretford meadows, and
“ which is nine hundred yards long, seventeen feet high, and an
“ hundred and twelve feet in breadth at bottom. Upon the top of this
“ they have carried the canal, eight yards broad, four feet deep ; and
“ one towing-path on each side, ten feet broad. After this difficulty, I
“ should think nothing too much for money to do, joined with a tolera-
“ ble judgment, and some ingenuity. I cannot tell what these canals,
“ &c. have cost the duke ; and I suppose the world will never know,
“ but by report : one may compute one hundred thousand pounds or
“ upwards ; which is not only the greatest undertaking that ever was
“ executed by any one subject of this nation, but I may add of all the
“ world.

“ I have now shewn, I hope, that an inland navigation may be made
“ by cutting canals through the lands, much easier and better than
“ pounding up the rapid current of a river by locks. I shall, therefore,
“ now proceed upon that principle and plan, and make the following
“ proposal to the merchants of Bristol, Liverpool, and Hull, and the
“ intermediate

“intermediate inhabitants, as well as to the great council of the nation.”

Yet notwithstanding the duke's undertaking was accomplished to the satisfaction of every beholder, and the difference in favour of canal navigation contrasted to that of a river was never more exemplified, nor appeared to more full and striking advantage than at Barton-bridge, in Lancashire, where one may see, at the same time, seven or eight stout fellows labouring like slaves to drag a boat slowly up the river Irwell, and one horse or mule, or sometimes two men at most, drawing five or six of the duke's barges, linked together, at a great rate upon the canal, which is carried over the river at this place like a magnificent Roman aqueduct; and notwithstanding the above gentleman's treatise was published in 1766, which convinced not only nine hundred out of a thousand, but nine hundred and ninety-nine, that canal navigation by still water was the best, and experience tells us the most useful; yet, I say, we find in 1768 an advocate for river navigation, even after Mr. Smeaton had surveyed and delivered in his estimates to join the Forth and Clyde, whose objections I shall consider and particularize hereafter.

I cannot take leave of the duke of Bridgewater with any propriety, without mentioning a few of those leading particulars, which prove the great depth of the duke's understanding, and the well-placed confidence he reposed in Mr. Brindley, who will be admired by succeeding generations. For it must be observed, that the duke had no facts performed, no demonstrations to revert to, nor any copy to follow to set himself right: but, actuated by his own discernment, and guided by the genius of his faithful Brindley, he consented to become the original, and set an illustrious example for others to follow. Mr. Brindley I must mention once more, who was his grace's principal engineer, and one of those geniuses which nature sometimes rears by her own force, and brings to maturity without the necessity of cultivation. His whole plan was admirable, and so well concerted, that he was never at a loss; for,

for, if any difficulty arose, he removed it with a facility that appeared like inspiration, and that without the least appearance of vanity or ostentation; for, being without education, he too well knew his inferiority in that point; and having no sinister ends to gratify, no contracted notions and ideas, nor jealousy of rivals, he concealed not his methods of proceeding, nor asked or solicited patents for the sole use of machines, which he invented and exposed to public view. His method of draining coal-pits by a fire engine, constructed at an expence not exceeding one hundred and fifty pounds, which no one before knew how to make for less than five hundred, is a beneficial improvement to the public, which is indebted to him for the invention; nor must I omit a mill near the mouth of the subterraneous passage, and which, though an over-shot mill, is so well contrived as to work three pair of grinding-stones for corn, a dressing or boulding mill, and a machine for sifting sand and compounding mortar. The mortar is made by a large stone laid horizontally, and turned by a cog wheel underneath it: this stone on which the mortar is laid turns in its course two other stones, that are placed upon it obliquely, and by their weight and friction work the mortar underneath, which is tempered and taken off by a man or stout lad employed for that purpose.

He also has invented portable cranes, of uncommon construction, to draw stone out of the quarry by callipers. His water-bellows, at the mouth of the cavern, equally deserve notice. These consist only of the body of a tree forming a hollow cylinder standing upright; upon which a wooden basin is fixed in the form of a funnel, which receives a current of water from the higher ground: this water falls into the cylinder, issues out at the bottom of it, and carries a quantity of air, which is received into tin pipes, and forced into the inmost recesses of the coal-pits, where it rarifies the body of thick air, which would otherwise prevent the workmen from existing on the spot where the coals are dug. Numerous other machines and contrivances have been invented by Mr. Brindley, and all upon the most plain and simple construction, all
tending

tending to save great expence and trouble: and here it may not be improper to insert some particulars of the life of this extraordinary mechanic, extracted from the *Biographia Britannica*.

Mr. JAMES BRINDLEY, a man of a most uncommon genius for mechanical inventions, and who particularly excelled in planning and conducting inland navigations, was born at Tunsted, in the parish of Wormhill, and county of Derby, in the year 1716. His parents dissipated away the little freehold they were possessed of, and young Brindley was totally neglected in education, and in his earliest part of life contributed to their support, and till he was seventeen years of age was employed in those light kinds of labour which are usually assigned in country places to the children of the poor. At this period of his life he bound himself apprentice to one Bennet, a mill-wright, near Macclesfield in Cheshire, and became very expert in the business: he quickly discovered a strong attachment to the mechanic arts in general: in the early part of his apprenticeship he was often left for whole weeks together by his master, without any previous instructions, who was often astonished at the improvements he had introduced into the mill-wright business; and the millers, wherever he was employed, always chose him in preference to his master, or any other workman.

It may not be amiss to mention a singular instance of our young mechanic's active and earnest attention to the improvement of mill-work. His master having been employed to build an engine paper-mill, which was the first of the kind that had been attempted in those parts, went to see one of them at work, as a model to copy after. But notwithstanding this, when he had begun to build the mill, and prepare the wheels, the people of the neighbourhood were informed by a mill-wright, who happened to travel that road, that Mr. Bennet was throwing his employer's money away, and could not complete what he had undertaken. Mr. Brindley, hearing of this report, was resolved to see the mill intended to be copied: accordingly, without mentioning his intentions,

intentions, he set out on a Saturday evening, after working the day, travelled fifty miles on foot, took a view of the mill, and returned back in time for his work on Monday morning; informed Mr. Bennet wherein he had been deficient, and completed the engine to the entire satisfaction of the proprietors. Besides this, he made a considerable improvement in the press-paper.

Mr. Brindley engaged in the mill business on his own account, and, by many useful inventions and contrivances, advanced it to a higher degree of perfection than it had ever attained. By degrees his fame began to spread itself wider in the country, and his genius was no longer confined to the particular branch of a mill-wright. In the year 1752 he erected a very extraordinary water-engine at Clifton, in Lancashire, for the purpose of draining some coal-mines, which before were worked at an enormous expence. The water for the use of this engine was brought out of the river Irwell by a subterraneous tunnel, six hundred yards in length, carried through a rock, and the wheel was fixed thirty feet below the surface of the ground. Mr. Brindley's superior skill in mechanics being now well known in that part of the kingdom, his reputation reached the metropolis, and he was employed by N. Patterson, Esq. of London, and some other gentlemen, in 1755, to execute the larger wheels for a new silk-mill, at Congleton in Cheshire. The execution of the smaller wheels, and of the more complex part of the machinery, was committed to another person, who had the superintendency of the whole; but who was not, however, equal to the undertaking, and confessed himself unable to complete it. The proprietors were greatly alarmed, and called in the assistance of Mr. Brindley, but still left the chief management to the former engineer, who refused to let him see the whole model, and affected to treat him as a common mechanic. Mr. Brindley, who, in the consciousness of genius, felt his own superiority to the man who thus assumed an ascendancy over him, would not submit to such unworthy treatment. He told the proprietors, that if they would let him know what was the effect that they wished

wished to have produced, and would permit him to perform the business in his own way, he would engage to finish the mill to their satisfaction. This assurance, joined with the knowledge they had of his ability and integrity, induced them to trust the completion of the mill solely to his care; and he accomplished that very curious and complex piece of machinery, in a manner far superior to the expectation of his employers, by constructions of many new and useful improvements; particularly one for winding the silk upon the bobbins equally, and not in wreaths; and another for stopping, in an instant, not only the whole of this extensive system, throughout its various and numerous apartments, but any part of it individually. He invented likewise machines for making all the tooth and pinion wheels of the different engines. These wheels had hitherto been cut by hand, with great labour. But by means of Mr. Brindley's machines, as much work could be performed in one day as had heretofore required fourteen. The potteries in Staffordshire were also much indebted to him for additions in their mills, for grinding flint stones with more facility. In the year 1756 Mr. Brindley undertook to erect a steam engine, near Newcastle-under-Line, upon a new plan: the boiler of it was made with brick and stone instead of iron, and the water was heated by fire-flues of a peculiar construction, by which contrivances the consumption of fuel, necessary for working a steam engine, was reduced to one half. He introduced likewise into this engine cylinders of wood made in the manner of coopers' ware, instead of iron ones; the former being not only cheaper, but more easily managed in the shafts: and he substituted wood too for iron in the chains, which worked at the end of the beam. His inventive genius displayed itself in various other useful contrivances.

Mr. Brindley's attention to this part of mechanics was soon called off to an object of the highest national importance; namely, the projecting and executing of Inland Navigations, from whence the greatest advantages arise to trade and commerce. In this period of our great me-

chanic's life, we shall see the powers given him by the God of nature displayed in the production of events, which, in any age less pregnant with admirable works of ingenuity than the present, would have constituted a national æra. We shall see him triumphing over all suggestions of envy or prejudice, though aided by the weight of established customs, and giving full scope to the operations of a strong and comprehensive mind, which was equal to the most arduous undertakings. This he did under the protection of a noble duke, who had the discernment to single him out, and the steadiness and generosity to support him against the opinions of those who treated Mr. Brindley's plans as chimeras, and laughed at his patron as an idle projector.

His grace the duke of Bridgewater, as has been observed before, hath at Worsley, about seven miles from Manchester, a large estate that is rich in mines of coal, which hitherto had lain useless, because the expence of land carriage was too great to find a market for consumption. The duke, wishing to work these mines, perceived the necessity of a canal from Worsley to Manchester; upon which occasion Mr. Brindley was consulted. Having surveyed the ground, he declared the scheme to be practicable, and obtained an act for that purpose; the success of which I have before described, being the first of the kind ever attempted in England. The principle laid down at the commencement of this business reflects much honour on the noble undertaker, as well as upon his engineer. It was resolved, that the canal should be perfect in its kind, and that, in order to preserve the level of the water, it should be free from the usual obstructions of locks. But in accomplishing this end many difficulties were deemed insurmountable. It was necessary that the canal should be carried over rivers, and many large and deep valleys, where it was evident that such stupendous mounds of earth must be raised, as could scarcely, it was thought, be completed by the labour of ages; and above all, it was not known from what source so large a supply of water could be drawn, even on this improved plan, as would be requisite for the navigation. But Mr. Brindley,

ley, with a strength of mind peculiar to himself, and being possessed of the confidence of his great patron, contrived such admirable machines, and took such methods to facilitate the progress of the work, that the world began to wonder how it could have been esteemed so difficult.

When the canal was completed as far as Barton, where the Irwell is navigable for large vessels, Mr. Brindley proposed to carry it over that river by an aqueduct thirty-nine feet above the surface of the water in the river. This, however, being generally considered as a wild and extravagant project, he desired, in order to justify his conduct towards his noble employer, that the opinion of another engineer might be taken; believing that he could easily convince an intelligent person of the practicability of his design. A gentleman of eminence was accordingly called in; who, being conducted to the place where it was intended that the aqueduct should be made, ridiculed the attempt; and when the height and dimensions were communicated to him, he exclaimed: "I have often heard of castles in the air, but never was before shewn where any of them were to be erected." This unfavourable verdict did not deter the duke of Bridgewater from following the opinion of his own engineer. The aqueduct was immediately begun; and it was carried on with such rapidity and success as astonished all those who but a little before condemned it as a chimerical scheme. This work commenced in September 1760, and the first boat sailed over it on the 17th July 1761. The particulars of the completing and finishing this navigation to Runcom Gap into the Mersey I have before described.

The success of the duke of Bridgewater's undertakings encouraged a number of gentlemen and manufacturers in Staffordshire to revive the idea of a canal navigation through that country, and Mr. Brindley was engaged to survey it from the Trent to the Mersey; and upon his reporting, that it was practicable to construct a canal from one of those rivers to the other, and thereby unite the ports of Liverpool and Hull,
in

in 1766 this canal was begun by him, called the Grand Trunk Navigation, and conducted with great spirit and success as long as he lived, and was finished by his brother-in-law Mr. Henshall, who put the finishing hand to it in May 1777, to the general satisfaction of the proprietors, and joyfulness of the whole country. This canal is ninety-three miles in length, and, besides a large number of bridges over it, has seventy-six locks, and five tunnels. The most remarkable of the tunnels is the subterraneous passage of Harecastle, which is two thousand eight hundred and eighty yards in length, and more than seventy yards below the surface of the earth. The scheme of this inland navigation had employed the thoughts of the ingenious part of the kingdom for upwards of twenty years before, and surveys had been made; but Harecastle Hill, through which the tunnel is constructed, could neither be avoided nor overcome by any expedient the ablest engineers could contrive or devise. It was Mr. Brindley alone who surmounted this, and such other difficulties arising from the variety of measures, strata, and quicksands, as no one but himself would have attempted to conquer.

Soon after the navigation from the Trent to the Mersey was undertaken, Mr. Brindley designed and executed a canal from the Grand Trunk at Haywood to the river Severn, near Bewdley, whereby the port of Bristol was united to the ports of Liverpool and Hull. This canal is forty-six miles in length, and was completed in 1772. Mr. Brindley's next undertaking was the survey and execution of a canal from Birmingham to unite with the Staffordshire and Worcestershire canal, near Wolverhampton. This navigation was finished in about three years, and is twenty-six miles in length. The canal from Droitwich to the river Severn, for the conveyance of salt and coals, was executed also by Mr. Brindley. He likewise planned the Coventry navigation, and it was a short time under his direction. But a dispute arising concerning the mode of execution, he resigned his office, which it is imagined the proprietors of that undertaking have since had cause to lament. Some little time before his death Mr. Brindley began the

Oxfordshire

Oxfordshire canal, which unites with the Coventry canal; and that, with the Grand Trunk, will form an inland navigation from Liverpool and Hull to London. Although they were soon deprived of their able engineer, the work was carried on with spirit, and finished with success.

The canal from Chesterfield to the river Trent at Stockwith was the last public undertaking in which Mr. Brindley was engaged: he surveyed and planned the whole, and executed some miles of the navigation, which was successfully finished by Mr. Henshall in 1777. There were few works of this nature projected in the kingdom, in which our engineer was not consulted. He was employed in particular by the city of London, to survey a course for a canal from Sunning, near Reading, in Berkshire, to Monkey Island, near Richmond; but when application was made to parliament for leave to effect their design, the bill met with such a violent opposition from the land-owners, that it was defeated. Those fine gentlemen would not suffer their villas to be disturbed by noisy boatmen, or their extensive lawns to be cut through for the accommodation of trade and commerce; though it was from trade and commerce that most of their fine villas and extensive lawns had derived their origin.

Mr. Brindley had for some time the direction of the Calder navigation; but he declined a farther inspection of it on account of a difference of opinion among the commissioners. In the year 1766 he laid out a canal from the river Calder, at Cooper's-bridge, to Huddersfield in Yorkshire, which hath since been carried into execution. In 1768 he revised the plan for the inland navigation from Leeds to Liverpool. He was also appointed the engineer for conducting the work; but the multiplicity of his other engagements obliged him to decline this employment. In the same year he planned a canal from Stockton, by Darlington, to Winston in the bishoprick of Durham. Three plans of the like kind were formed by him in 1769; one from Leeds to Selby, another from the Bristol channel, near Uphill in Somersetshire, to Glastonbury,

Glastonbury, Taunton, Wellington, Tiverton, and Exeter; and a third from Langport, in the county of Somerset, by way of Ilminster, Chard, and Axminster, to the south channel at Exmouth, in the county of Devon. In 1770 he surveyed the country for a canal from Andover, by the way of Stockbridge and Rumsey, to Redbridge near Southampton; and in 1771, from Salisbury, by Fordingbridge and Ringwood, to Christchurch. He performed also, in 1772, the survey for a navigation proposed to be carried from Preston to Lancaster; and from thence to Kendal, in Westmoreland. He surveyed likewise, and planned out, a canal to join that of the duke of Bridgewater's, at Runcorn, from Liverpool. If this scheme had been executed, it was Mr. Brindley's intention to have constructed the work by an aqueduct over the river Mersey, at a place where the tide flows fourteen feet in height. He also surveyed the county of Chester, for a canal from the Grand Trunk to the city of Chester. The plan for joining the Forth and Clyde was revised by him; and he proposed some considerable alterations, particularly with regard to the deepening the Clyde, which have been attended to by the managers. He was consulted upon several improvements with respect to the draining of the low lands in different parts of Lincolnshire, and the Isle of Ely. A canal was also laid out by him for uniting that of Chesterfield, by the way of Derby, with the Grand Trunk at Swarkestone. To the corporation of Liverpool he gave a plan for cleansing their docks of mud, which hath been carried into execution with the desired effect; and he pointed out also the method, which has been attended with equal success, of building walls against the sea without mortar. The last of our great mechanic's ingenious and uncommon contrivances that we shall mention, is his improvement of the machine for drawing water out of mines by a losing and a gaining bucket. This he afterwards employed to advantage in raising up coals from the mines.

When any extraordinary difficulty occurred to Mr. Brindley in the execution of his works, having little or no assistance from books, or the labours

labours of other men, his resources lay within himself: in order therefore to be quiet and uninterrupted whilst he was in search of the necessary expedients, he generally retired to his bed; and he has been known to lie there one, two, or three days, till he had attained the object in view. He would then get up, and execute his design without any drawing or model. Indeed, it never was his custom to make either, unless he was obliged to do it to satisfy his employers. His memory was so remarkable, that he has often declared, that he could remember and execute all the parts of the most complex machines, provided he had sufficient time to settle in his mind the several departments, and their relations to each other. His method of calculating the powers of any machine invented by him was peculiar to himself. He worked the question for some time in his head, and then put down the result in figures. After this, taking it up again in that stage, he worked it farther in his mind for a certain time, and set down the results as before. In the same way he still proceeded, making use of figures only at stated periods of the question; yet the ultimate result was generally true, though the road he travelled in search of it was unknown to all but himself, and perhaps it would not have been in his power to have shewn it to another.

The attention which was paid by Mr. Brindley to objects of peculiar magnitude, did not permit him the common diversions of life. He never seemed in his element, if he was not either planning or executing some great work, or conversing with his friends upon subjects of importance. He was once prevailed upon, when in London, to see a play, having never been at an entertainment of this kind before. It had a powerful effect upon him, and he complained for several days afterwards, that it had disturbed his ideas, and rendered him unfit for business. He declared, therefore, that he would not go to see another play upon any account. It might, however, have contributed to the longer duration of Mr. Brindley's life, and consequently to the farther benefit of the public, if he could occasionally have relaxed the tone of

his mind. His not being able to do so might not solely arise from the vigour of his genius, always employed on great designs, but be, in part, the result of that total want of education, which, while it might add strength to his powers in the particular way in which they were exerted, precluded him at the same time from those agreeable reliefs that are administered by miscellaneous reading, and a taste in the polite and elegant arts. The only fault he was observed to fall into, was his suffering himself to be prevailed on to engage in more concerns than could be completely attended to by any single man, how eminent soever might be his abilities and diligence. It is apprehended, that by this means Mr. Brindley shortened his days, and in a certain degree abridged his usefulness. There is at least the utmost reason to believe that his intense application in general to the important undertakings he had in hand, brought on a hectic fever, which continued upon him some years with little or no intermission, and at length terminated his life. He died at Turnhurst in Staffordshire, on the 27th of September 1772, in the 56th year of his age, and was buried at New Chapel in the same county. The vast works Mr. Brindley was engaged in at the time of his death he left to be carried on and completed by his brother-in-law Mr. Henshall, for whom he had a peculiar regard, and of whose integrity and abilities, in conducting these works, he had the highest opinion.

Thus was the world deprived, at a comparatively early period, of this great genius,

“Of mother wit, and wise without the schools,”

who very soon gave great indications of uncommon talents and extensive views in the application of mechanical principles, and who, by a happy concurrence of circumstances, the chief of which was the patronage of his grace the duke of Bridgewater, was favoured with an opportunity of unfolding and displaying his wonderful powers in the execution

execution of works new to this country, and such as will extend his fame, and endear his memory to future times. The public could only recognise the merit of this extraordinary man in the stupendous undertakings which he carried to perfection, and exhibited to general view. But those who had the advantage of conversing with him familiarly, and of knowing him well in his private character, respected him still more for the uniform and unshaken integrity of his conduct, for his steady attachment to the interest of the community, for the vast compass of his understanding, which seemed to have a natural affinity with all grand objects, and likewise for many noble and beneficent designs, constantly generating in his mind, and which the multiplicity of his engagements, and the shortness of his life, prevented him from bringing to maturity.

An anonymous friend (as he styles himself) of Mr. Brindley says, "He was the greatest enthusiast in favour of artificial navigations that ever existed. Having spoken upon various circumstances of rivers before a committee of the House of Commons, in which he seemed to treat all sorts of rivers with great contempt, a member asked him, for what purpose he apprehended rivers were created? Mr. Brindley, considering with himself a moment before he gave an answer, replied at last, *To feed navigable canals.*

"Employment in so many considerable works had made him think there was nothing impossible to him. He had always a favourite scheme of joining the two islands by a floating road and canal from Port Patrick to Donaghadee, which he was confident he could execute in such a manner as to withstand the most violent attacks of the waves.

"He had been so lowly educated, that he had learned neither to read nor write, and afterwards went no farther than signing his name; yet he could cast up pretty intricate accounts in his head without difficulty or error.

"The late king of France, upon hearing what he had performed, had an inclination to see him, and to have him view the canal of Languedoc; but he said he would make no journeys to other countries, unless it were to be employed in surpassing what was already done in them.

"Clear as his head must have been, he had, in delivering his opinion, so unmeaning and poor a way of expressing himself, that he was taken by many for an idiot." So far this anonymous writer; which, if true, will contribute still farther to display Mr. Brindley's turn of mind: but one part of his information is erroneous; for Mr. Brindley could both read and write, although but poorly: and he was so far from looking like an idiot, that he had an animated and sensible countenance.

We cannot conclude the present article better than by transcribing from one of our first female poets some lines beautifully descriptive of the new objects, which are presented in a rural landscape by navigable canals.

Here smooth canals across th' extended plain
 Stretch their long arms, to join the distant main:
 The sons of toil, with many a weary stroke,
 Scoop the hard bosom of the solid rock;
 Resistless thro' the stiff opposing clay
 With steady patience work their gradual way;
 Compel the genius of th' unwilling flood
 Thro' the brown horrors of the aged wood:
 'Cross the lone waste the silver urn they pour,
 And cheer the barren heath or fullen moor.
 The traveller with pleasing wonder sees
 The white sail gleaming thro' the dusky trees,
 And views the alter'd landscape with surprise,
 And doubts the magic scenes which round him rise:

Now

- * Now meeting streams in artful mazes glide ;
- * While each unmingled pours a separate tide ;
- * Now thro' the hidden veins of earth they flow,
- * And visit fulphurous mines and caves below ;
- * The ductile streams obey the guiding hand,
- * And social plenty circles round the land.'

I shall now add a short account of the internal structure and appearance of the duke's coal mine ; which may serve for a description of other mines, whether of coal, iron, or any other kind.

You enter with lighted candles the subterraneous passage in a boat made for bringing out the coals, forty-seven feet long, four feet and a half broad, including the gunnels, and two feet six inches deep. This boat, when loaded, carries about seven tons, or sometimes eight. In this manner you proceed up the canal to the lake at the head of the mine, distant three quarters of a mile : the two folding doors at the mouth are immediately shut on your entrance to keep out too much air if the wind blows ; and you then proceed by the light of your candles, which cast a livid gloom, serving only to make darkness visible.

But this dismal gloom is rendered still more awful by the solemn echo of this subterraneous lake, which returns various and discordant sounds. At one moment you are struck with the grating noise of engines, which, by a curious contrivance, let down the coals into the boats. At another, you hear the shock of an explosion, occasioned by blowing up the hard rock, which will not yield to any other force than that of gun-powder ; immediately after perhaps your ears are saluted by the songs of merriment from either sex, who thus beguile their labours in the mine.

When you have reached the head of the works, a new scene opens to your view. There you behold men and women, almost in their primitive state of nature, toiling in different capacities, by the glimmering
of

of a dim taper : some digging the jetty ore out the bowels of the earth ; some again loading it into little waggons made for the purpose ; others drawing the waggons to the boats.

To a superficial observer such scenes serve only to amuse the eye by their novelty, but to a reflecting mind they afford ample matter of instruction. When we behold a part of our species deprived of sun-shine, the common inheritance of mankind, and buried in a dismal and confined cavern, in which they can scarcely stand upright, our feelings prompt us to commiserate their condition : but when we observe the lively ray of cheerfulness break forth in this scene of darkness and distress ; when we behold the glow of health in the midst of damps and suffocation, we then cease to pity them, and begin to examine ourselves ; we then discover that our enjoyments above ground serve only to multiply our wants ; and we are convinced of the truth of that maxim, which assures us, that happiness is every where, or no where.

NAVIGATION from LIVERPOOL to HULL.

WHILE the duke of Bridgewater's curious inland navigation was carrying on, there were several views and surveys taken, to discover if possible a route for an inland navigation from Liverpool to Hull. I cannot set this undertaking in a clearer point of view, than by extracts from the resolutions passed at the several meetings held on the subject, and from the different acts of parliament obtained, as also from a celebrated performance in which inland navigation is judiciously treated of. I shall likewise add some remarks and observations of my own, made on the different spots, as I have been employed in some of these works, and have attended others from curiosity ; for it is certain that there is a rational as well as ridiculous curiosity, and that this principle is either useful or injurious according to the disposition of the person in whom it prevails. In weak minds, it is the source of levity, and its concomitant

concomitant ill consequences ; but in noble and scientific minds it is the parent of industry, and the guide to every useful species of knowledge.

In beginning this subject it will be necessary to revert back as far as the year 1755, when the corporation of Liverpool, ever attentive to its trade and commerce, employed two gentlemen (Mr. Taylor of Manchester, and Mr. Eyes of Liverpool) to survey the country, and take levels, &c. with a view to join the river Trent to the Weever or Mersey, and to open a communication between those great sea-ports, Liverpool and Hull ; by which the traffic of the east and west seas might be carried on by an inland navigation, not exceeding one hundred and fifty miles, which now makes a circuit of above eight hundred miles, and is exposed to adverse and stormy winds. This inland navigation, it was proposed, should pass through Nottinghamshire, Derbyshire, Staffordshire, and Cheshire, and after an accurate survey it was found to be practicable. This survey was chiefly promoted by the late Mr. Hardman, an active and able friend to the commercial interests of this nation, and one of the representatives of that borough.

The public is indebted to the earl Gower (now marquis of Stafford) and the late lord Anson, for another survey of the intended course of this canal, made by Mr. Brindley in 1758, and afterwards reviewed by Mr. Smeaton, F. R. S. and Mr. Brindley, jointly ; and these surveyors concurred in opinion, that no tract of land in the kingdom was naturally better adapted for the purpose of an inland navigation, and that none stood in more need of it, or was so convenient for an union of the east and west seas.

In the year 1760, a public meeting was advertised and held at Sandon in Staffordshire, at which lord Gower, lord Anson, and a great number of the neighbouring gentlemen, land-owners and manufacturers, attended ; but difficulties arising, farther surveys were
I advised,

advised, and one thousand pounds subscribed for the extending of the survey from tideway to tideway. Another meeting was held the same year, and Mr. Brindley and Mr. Smeaton attended with their surveys, according to their last orders. The result of this meeting I shall mention hereafter, and give the reasons why the second plan was approved and executed in preference to the first.

C H A P. VIII.

Particulars of Two Plans for a Communication by Canals between Liverpool, Bristol, and Hull.—Course of the intended Canals to join the River Weaver in Cheshire to the Trent in Staffordshire.—Expence of cutting, and Length of these Canals.—Number of, and Expence of constructing, the Locks necessary to complete them.—Advantages of them to the Counties through which they would pass, and to the Nation at large.

IN the year 1765 two plans were offered to the public, for a navigable cut or canal to form a communication between those great sea-ports Bristol, Liverpool, and Hull, by a junction of the rivers Severn, Trent, and Weaver or Mersey; and as a great many gentlemen in the counties, through which these rivers pass, were divided in their opinions, some giving the preference to one plan, and some to the other; and as both the plans would be of the utmost advantage and utility to the land-owners and manufacturers of the places through and near which the proposed canals should pass; I will, with permission, describe both in as concise a manner as possible; and as one of them was approved, and is executed, the impartial will be enabled to judge for themselves, which seemed calculated to be most beneficial to the country. And first, I shall describe the plan and route of the canal, which was laid down by the author of the Advantages of Inland Navigation, and which is marked in the map with dotted lines. This writer was a gentleman of such property and local knowledge of the counties, and the trade and manufactures carried on in them (himself living in the centre of them), that I am greatly surpris'd his plan was not approved,

excepting in two particulars, in which it is, I think, very objectionable. These are, first, his not going into the Severn lower down nearer Bewdley, than where his intention was at Tern-bridge near Shrewsbury, to avoid the shallows which lie between Bewdley and Shrewsbury, and must greatly regard the navigation between those two towns. The other is his not going into the river Mersey at Runcom Gap, or into the duke of Bridgewater's canal at Preston Brook, which falls into the Mersey at Runcom Gap, rather than, as by his plan, into the river Weaver, at Winsford-bridge, on account of the number of locks from thence to the tideway to go to Liverpool. It is also to be observed, that if it had joined the duke of Bridgewater's canal at Preston Brook, the goods and merchandise brought by the canal from Hull and Bristol, by the Severn and Trent, might have been conveyed to Manchester, without going down those locks, seventy-five feet into the river Weaver, and up as many more into the duke's canal: besides going round a point of land, and being liable to the obstructions of neap tides and adverse winds, by which barges may be retarded several days, and which I will more particularly explain, after I have given the route of both canals. But before I proceed, it will be proper to observe, that the route of the canals in both plans is exactly alike from Shutborough in Staffordshire, down the river Trent to Wilfden Ferry, in order to avoid the shallows between Burton and Wilfden, rather than fall into the Trent, at Burton, which would save a cut of fifteen miles. If the obstacle occasioned by the shallows was observed there, how it should have escaped the notice of a person of such discernment and penetration, as the gentleman who planned the first route, is to me inconceivable.

To begin then with the first plan for a communication between Bristol and Hull. It was proposed, that the said canal should pass from or near a place called Tern-bridge, on the river Severn, in the county of Salop; and from thence a little higher up than the course of the river Wroxeter, cross the Uppington road, by Wanford and Allscot, and cross the road leading on the right to Wellington; thence by

Crudgington (where the river Tern comes from Drayton); thence up by the Wildmoors, by or near Chetwin Park, on the side of Pilson Hill; thence cross the low grounds near Flashbrooke Hall, in the parish of Adbaston, making its first entrance into Staffordshire, at Whitley Ford, and proceeding thence by the river Whit, at Batchacre Grange, and by the side of the Hill Park, along Tunstall Moor, into the valley below Offley Park mills, where the highest summit of land is; thence it was to cross the brook that runs from Cockmere, in Eccleshall parish; and proceed by Pershall low grounds, Eccleshall and Byanna, down the valley to Hilcot and Chebsey, to the river Sow, that comes from Standon, where, about a mile and a quarter above Bridgford, the proposed navigation from Liverpool, by the river Weaver, was to unite with the Bristol. It was then to proceed along the meadows on the right-hand side the river to Stafford; from thence down by the river Sow, across the Penk, and by Baswich to Haywood Park; from thence by the river Trent, crossing the same near Wolfely-bridge; and thence behind Bishton House, over the river by Rudgeley, across the brook by Lee Hall, Armitage, and Bromley, and across the river at Whichnor; thence by Branston and Seany Park, leaving the town of Burton on the right, by Monk's-bridge, across the river Dove to Eggington, being its first entrance into Derbyshire; and from thence by Willington and Twyford, on the right by Cliff Hill, Black Pool, and Weston; thence into the river Trent, at Mr. Drake's warehouse at Wilden, where the river Trent is navigable without any inconvenience from locks, though there are some few shallows by Newark, Nottingham, and Gainborough, to the great sea-port at Hull.

LIVERPOOL BRANCH to the BRISTOL BRANCH.

HAVING planned out the course of the canal from Bristol to Hull, I have now only to describe the course of the Liverpool navigation from the Mersey (I believe the river meant is the Weaver) to the place

where it unites with the Bristol canal (which I before observed must be at Bridgford, near Stafford). The river Weaver falls into the Mersey at Frodsham, and is now by act of parliament made navigable by the means of locks as far as Northwich, and further up to Winsford, for the conveniency of conveying the produce of the salt-works to Liverpool. I would therefore propose, says my author, that a navigable canal should be made from Winsford, on the river Weaver, by Weaver Bank, Minshull, and Barton Cross, near Nantwich; from thence along the valley to Wybunbury, Checkley, and Rynhill Hall (where it quits the county of Chester, and enters Staffordshire); from thence through Madeley Park, being the highest summit of land (between which place and Whitmore the river Sow takes its rise, and runs in a south-east course to Stafford); from thence near Whitmore, Stapleford-bridge, Standon, Walford, Millmeese, Coldmeese, Shallowford, and Bridgford, where it must unite with the Bristol canal, and proceed to Wilden, and so, according to the route before described, to Hull.

As I speak from the authority of surveys that have been taken, I make not the least doubt but the above scheme is both practicable and very easy to be executed at no very large expence, considering the great national utility it will be of, even to every individual, whose state of existence is not of the dormouse kind, and whose degree of capacity is only a small matter removed from the idiot, and will suffer him to feed himself. I will, therefore, proceed to shew how the same may be executed, after what manner; and, in regard to the expence, will calculate and come to as near a certainty as the nature of these sorts of undertakings will admit of.

I would first propose, says my author, that the land to be purchased should be eighteen yards broad; that the canal should be in breadth at the top of the water nine yards, and six at the bottom; and that there should be two towing-paths, four yards and a half each, on the sides of the canal; that the depth of the water should be at least five feet, on
account

account of the different sorts of boats that are likely to navigate it: but as there ought to be some restriction with respect to the make of the boats, I should think they ought to be fifty feet long, eleven feet broad, and built much after the manner and form of those made at Bridgenorth on the Severn; nor ought they to draw more than three feet and a half of water when loaded. This kind of boats would better suit the navigation, in regard to passing one another, and the preservation of the banks, and may be so built as to carry thirty tons burthen, and may cost about fifty pounds with a mast, main-sail, and towing-line, &c. There might be a covered place in the steerage for a man and a boy to lie in, as they frequently want such convenience, especially where the country through which they pass is thinly inhabited; and also, when they have any valuable goods on board, as it would then be imprudent in them to lie on shore, lest they should be stolen. There might also be a forecastle, six or eight feet long, towards the stem. These vessels will carry goods from Bristol to Liverpool or Hull, without the trouble and fresh expence of reshipping; as those boats now used by the duke of Bridgewater on his canals in Lancashire will not bear the navigating the tide's way beyond the Hempstones, and on that account are both troublesome and expensive, being seventy feet long, and six feet broad, and liable to great and numberless inconveniences. They also require double the quantity of water and labour, in carrying the same quantity of goods through a lock, that the vessels I have here proposed do, exclusive of the expence, trouble, and inconveniency of reshipping. The sort of boats most convenient cannot be properly ascertained till the canals are finished, as perhaps boats otherwise constructed will appear to be equally useful with those I have here described.

As this navigation must be open to all persons, it will therefore be somewhat difficult to confine every one to have their boats built in such a certain manner as to prevent their damaging, in their passage, any part of the banks of the canals, and to procure the observance

observance of all such rules and orders as may be made for the good of the same; upon that account I have allowed as great a breadth for the top of the canals as possible, to obviate the above inconveniences which are avoided in private navigation, where all the vessels that can be used upon it are the property of one person, and the whole, together with both men and boats, immediately under his directions.

The expence of these canals will come to about nine hundred pounds a mile, including the purchase of lands, erecting locks, building bridges, and making the proper paths on each side for towing the boats; and surely this is not to be considered as a large sum, when it is well known that many turnpike roads in England have cost a thousand pounds a mile to repair them. Then let us imagine the vast difference there will be in the carriage of goods, &c. between one and the other. We will say for example, that on a mile of any such turnpike roads one thousand tons of goods may be carried in a year, and in all probability the passage of goods upon one mile of these canals may not be so little as one hundred thousand tons: therefore, why can we think the expence great, according to this proportion of repairing turnpikes, when all goods may be conveyed from east to west, much cheaper and safer than any other way by these navigable canals, and the price of carriage will always continue the same; whereas land carriage differs according to the badness of the roads, or the number of carriers, and is very often subject to great inconveniences, not to mention that all kinds of brittle goods are subject to be broke in pieces by loading and unloading into different waggons? It must therefore be allowed, that water carriage is undoubtedly preferable to land carriage, especially on these canals where boats would meet with no difficulties, but always arrive at their station by the appointed time.

The distances from place to place are as follow: From Tern-bridge, where the canal begins, opposite to Batchacre Grange, twenty miles nine perches; from thence to the highest point of land in the course of
of

of the canal, below Offley Park, four miles five perches; from thence to the junction of the river Sow, where the Liverpool canal joins, six miles; thence to Bridgford, one mile and a quarter; which makes thirty-one miles and a quarter, and one perch. To Stafford, three miles and three perches; from Stafford to or near Wolfeley-bridge, where the river Trent is crossed by the canal, six miles and a quarter; from thence by Bishton to Wilden Ferry, thirty-two miles; which makes forty-two miles. The distances on the Liverpool canal are as follow: From the meadow above Bridgford in Staffordshire, where it joins the Bristol canal to Madeley Park, being the highest summit of land in the course of the canal, near which place the canal runs both ways, north-west and south-east, is ten miles two quarters; from thence to Barton Cross, thirteen miles; from thence to Winsford-bridge in Cheshire, nine miles, one quarter, and six perches; which makes thirty-two miles, three quarters, and six perches.

The fall westward, between Tern-bridge and the highest summit of land in the canal course, where the water runs both ways, east and west, which is in the valley below Offley Park, is one hundred and thirty-six feet nine inches; from thence to Bridgford eastward, it is fifty-four feet eight inches; from Bridgford to Stafford Mill Pool, from thence to the crossing the Trent, near Wolfeley-bridge, and from thence to Wilden Ferry, it is one hundred and sixty feet. Between Bridgford, in the Liverpool canal, and the summit in Madeley Park, the fall is one hundred feet three inches; and from thence to the Weaver, which runs a north-west by west course to Winsford, it is two hundred eighty-four feet one inch.

It is not material here to enumerate at length the distances and falls of water: I shall pass them over, and proceed to observations of more importance. The reader must here observe, that the high summit of land between Offley Park and Cockmere Brook, being a distance of a mile and half, is an elevation of twenty-five feet, into which I propose digging

digging and removing the earth eighteen yards wide, the breadth of the canal, towing-paths, and drains: which we reduce to a level that breadth, and a fall decreasing each way for a mile and half. In the whole, there must be removed at a medium one hundred ninety-eight thousand and fifteen cubic yards of earth, which, at three-pence per cubic yard, would cost two thousand four hundred and seventy-five pounds three shillings and eleven pence; which reduces the level, and makes the fall to Tern-bridge westward, one hundred and thirty-six feet nine inches; and to Bridgford eastward, fifty feet eight inches: by which means four locks at least will be saved.

It must also be observed, that the high point of land at Madeley Park is likewise an elevation of twenty-five feet for a mile and a half, which I would also propose to remove for the length of a mile and a half, and eighteen yards in breadth, decreasing also each way (as both of them are in light ground, this might be done with little labour); and to reduce the whole of this elevation as above, there must be removed, at a medium, one hundred and ninety-eight thousand and fifteen cubic yards of earth, which, at three-pence per cubic yard, would cost two thousand four hundred and seventy-five pounds three shillings and eleven-pence, which will reduce the fall south-east to the junction of the canal above Bridgford, to one hundred feet three inches and a quarter; and from the said point, north-west to Winsford-bridge, to two hundred eighty-four feet one inch, by which means four locks at least will be saved.

As these distances and levels are taken by persons who have been at a very great expence in ascertaining them, they will no doubt be found very accurate; which is not the case with all surveys that are published, many of them being frequently erroneous. I shall now consider in what manner it will be necessary to proceed in order to the obtaining an act of parliament for executing this great design.

The

The author next subjoins a copy of the proposals for executing this great design.

Proposals (to be printed in all the public papers) for meetings to be held at Bristol, Liverpool, and Hull, and at all the intermediate towns, and to invite the masters of the great furnaces and forges at Sambrook, Keinton, Tibberton, Upton-under-Haymon, Coalbrook Dale, Ketley, Horsey, Wytheyford, Moreton, Willey, Pitchford, Sutton, Longnor, and all the large various iron manufactories lying upon the intended navigation or Severn, to attend and concur with the land-owners in a petition to parliament. Then follows the form of the petition, and also a memorandum of the agreement or consent of the land-owners, through whose lands the canal is to pass, and the form of a subscription paper for raising the sum necessary for an application to parliament. He next gives the proposals for raising the fund to defray the expences of making and finishing the said canals, which will require the sum of one hundred and sixteen thousand pounds; which sum, it is intended, shall be divided into five hundred and eighty shares of two hundred pounds each; and that no person shall have above twenty shares; and that the money shall be advanced by each subscriber in equal proportions, as the same shall from time to time be wanted; and bear lawful interest from the paying such sums till the navigation shall be completed; and from the time of the completion thereof, to receive the proportion of the profits arising thereby, according to their respective shares, which shall be made transferable by a form prescribed in the act.

The following are the resolutions agreed to:

“At a very numerous meeting of noblemen, gentlemen, land-owners, traders, and manufacturers, held at the sign of the Star at Stafford, the 10th day of August 1766, it was unanimously agreed,

Q

That

That application be made to parliament this session, for an act to make a navigable canal from the river Severn at Tern-bridge in the county of Salop, and the river Trent at Wilden in the county of Derby; and also from the river Weaver at Winsford-bridge, in the county of Chester, to communicate with the above at Bridgford, on the river Sow, in the county of Stafford :

That it will be most convenient for the execution of this undertaking, if the making and completing the said navigation, which has been estimated at one hundred and sixteen thousand pounds, were to be distributed into five hundred and eighty shares, and raised by subscription; that no person shall have more than twenty shares; the money to be advanced by each subscriber in equal proportions, as the same shall be wanted; and the shares made transferable by a form prescribed in the act :

That a subscription be immediately opened to raise a fund to support the necessary expences of procuring the act; that the money thus subscribed shall, after the obtaining of the act, be repaid to such persons as shall not be subscribers, and allowed to such as shall be subscribers, in part of payment of their shares :

That a subscription be also opened for the money which will be wanted for making and completing the said navigation; that twenty days be allowed after this day to complete the said subscription; that the names of the subscribers may be entered with _____ of Bristol, Gloucester, Worcester, Salop, Bewdley, Bridgnorth, Newport, Drayton, Eccleshall, Stafford, Litchfield, Tamworth, Birmingham, Wolverhampton, Dudley, Rudgley, Burton, Walsal, Derby, Nottingham, Newark, Gainfborough, Hull, Nantwich, Northwich, Newcastle, Congleton, Frodsham, Chester, and Liverpool, where books will be open and kept to receive subscriptions for that purpose; and an account is desired to be transmitted from each gentleman at the end of twenty days

days to of Stafford, (being about the centre) of the subscriptions at each place; and if the subscription shall not be then complete, to be left open until it is; the first subscribers to have the benefit, if the sums subscribed shall exceed the sum wanted; that subscribers are to have votes, according to the number of shares, in the annual choice of a convenient number of directors to be limited in the act, who shall have the management and inspection of the work; and that commissioners shall be named in the act, to determine all controversies and disputes that may arise: that proper provision shall be inserted in the act, for making full satisfaction to the land-owners and their tenants, for all lands to be taken in for the use of such navigation; and for all damages, both present and future, which they may sustain thereby; and for giving all proper conveniences to such land-owners, and their tenants; the same to be determined by commissioners or juries, where necessary, unless the parties agree otherwise: that it be proposed, for the consideration of parliament, that a proper toll be taken as tonnage, to be fixed by the act at about one shilling and six-pence per ton for each and every ten miles that each vessel shall pass upon the said navigation; and also that the subscribers may be paid five per cent. for their money in the respective sums advanced, from the time of their paying in the same till the whole communication between the three ports shall be completed; and from that time they may receive their proportion of profits, according to their shares; and that the subscribers be permitted to vote by proxy:

That no toll be taken for stone, gravel, or other materials for repairing the roads; nor for dung, soil, lime, or other manure used only for the improvement of land:

That these resolutions be printed in most of the public papers for three weeks successively.

The interest of the country and the public good are afterwards so
Q² judiciously

judiciously discussed in this excellent treatise, and the manner as well as matter of the natural produce and manufactures so particularly and minutely treated, that I should leave this part lame and defective were I to omit the author's observations on this subject. Besides, were I to describe the produce and manufactures on the route of one canal, and neglect them in the other, it would be impossible for an impartial judgment to be formed; therefore, I think it most conducive to the interest and pleasure of the reader to finish one account before I begin another: for this reason I shall resume the subject in the author's own words, or I should do injustice to all parties.

The author of the Advantages of Inland Navigation then goes on. "I have now gone through the forms and proceedings (except the levels and estimates, which will be given at the end of this treatise) necessary for obtaining an act of parliament, for the carrying into execution the foregoing plan of the navigation between the three great ports of Bristol, Liverpool, and Hull. I shall now proceed to add some observations on the inland trade, and the increase of the export trade of this country.

"The vast importance that trade is of to this nation is too frequently and too strongly instanced, even in the disturbances of any manufacture whatever, which seldom fail to draw not only the attention of the people, but also the serious consideration of the legislature, to interpose and alleviate their calamities and distresses. The late uneasiness of the weavers in London was a striking instance that the least indulgence to admit foreign goods into this kingdom (when our manufacturers in Spitalfields were able to furnish as good, if not better), and preferring them to our own, was a clog upon our trade; and the distress of a few had like to have embarrassed the rest of the nation to find redress for their complaints. Nor can I get out of my head the present stop to all sorts of trade (1766) in these parts, and the dreadful situation that thousands of families are in from the refusal the noble Americans have

have lately made of having any trade or communication with the mother state, entirely occasioned by an imprudent and ill-considered measure taken by the late administration, by advice of the financier Mr. G. G., in arbitrarily imposing the stamp act upon the Americans; in the illegality of which both reason, argument, and humanity have refused to be parties concerned.

“I have said, that to trade we owe our opulency, and for that convenience by far the greater number of this nation have fixed themselves in towns, and have stripped the country of every laborious cottager (lately swarming with a cluster of healthy children) by the landlords laying their farms into large takes: therefore, the greater numbers have got together, and trafficking with each other, it is natural even on that account to have the greater regard to their prosperity; and as they subsist by trade alone, it is fitting the nation should do all they can to protect, increase and encourage it; in short, it is by trade alone we live, and by society we are made happy, they being only brought about by an easy communication and connection one with another, throwing the whole nation as it were upon a kind of equality, giving to every man a liberty to improve. Among the ancients commerce did not appear unworthy the application of persons of the first rank. Solomon, we are told, frequently joined his merchants' fleets with those of the king of Tyre, for their voyage to Ophir; and by this means rendered himself, though in a little kingdom, the richest king of his time in the universe. How greatly did trade flourish under the Romans! what vast companies of merchants in the different cities are mentioned by our historians! and we always find, that those nations that abounded most in shipping and navigation were the first leaders in trade, and spread themselves in all the Levants ports and Egypt. The Greeks and Romans thus acquired their lustre and power; and upon the ruins of them is our modern commerce founded, trading to the same places. It is morally impossible for men to flourish without the assistance of each other, as well as any easy communication from place to place. What makes the
Dutch

Dutch not only vie with all the world in trade, but really eclipse them? What but their vast conveniences of inland navigation, by which the produce of all the internal parts of the provinces becomes an external commodity, and is carried to the furthest parts of the globe, returning to the industrious labourer (who was the original proprietor of what would have been of no value at his own home) triplefold, and the returns made in things the most useful to his family. It was the easiness and practicability of making canals that first led the Dutch to the desire of trade and commerce, in which it must undoubtedly be allowed they exceed all other nations, and entirely owing to their inland navigable canals. The trade of Great Britain may claim some place under the shield of commerce; but it seems astonishing to a cool considerate mind, that Britons should never heretofore have attempted inland navigations, nor endeavoured to effect an easy and mutual intercourse through the whole island, and let each subject share the gifts of nature in a more equal degree; by which means the exports would be doubly increased, and there would be a greater demand for the imports."—

“The advantages from these canals to this nation will be very great, as every person must allow that the stamina of our trade is the internal produce of the kingdom; and the nearer each manufacturer is to his market, the greater price his goods will take: for instance, if a person manufactures a piece of cloth (such as is usually sent abroad for sale to America, or elsewhere) in the county of Stafford, where he lives forty miles from the merchant's ship that is to carry it abroad, will he not be obliged to sell it, upon the account of heavy charge of land carriage, for a much less price than if he could convey it at an easy rate to a seaport by means of this canal, and there sell it at the same price that a factor would? Let us only consider, that the factor buys up the goods or manufactures of perhaps fifty poor persons, and conveys them to a merchant at a considerable large profit, which falls into the hands of the factor alone, and enriches only one; whereas, were each manufacturer to have a convenience of conveying his own goods directly to the merchant,

merchant, all the profits monopolized by the factor would be divided equally among the fifty poor persons, and enrich that number instead of one. The more hands any goods or merchandize go through the dearer they are to the consumer; as every person, through whose shop they go, must have a profit: but in this case, the factor monopolizes the whole profits of fifty poor manufacturers.

“ In case of invasion or rebellion, by these canals our government would be able to transport their very heaviest cannon to any part of the country in a very short time; as also regiments, and their baggage, might be conveyed in a much safer way than by long tedious harassing marches through roads that are almost impassable, and oftentimes very far round to the point to which they want to come: besides the saving in artillery horses, and the expence of baggage waggons to the government, which usually amounts to nearly as much as the pay of at least one third part of the regiment for the time. Every person must remember the great difficulties encountered in conveying the cannon and other military stores, in the inconsiderate rebellion in 1745, even four-score miles from the metropolis, so excessively bad and deep then were the high-roads of these western parts: and indeed, to speak the truth, were the government to have occasion now to convey the same military stores, there would be but little more expedition, unless they could be sent by navigable canals.

“ It has been a common objection against navigable canals in this kingdom, that numbers of people are supported by land carriage, and that navigable canals will be their ruin; and it has as often been said, to remedy that inconvenience, that those people may take to other trades, and turn either farmers or navigators, and, instead of driving a waggon, they may learn to steer and navigate a boat, which in time of war may turn out to the advantage of the navy, or merchants' service (upon both which most of our learned authors agree that our safety depends): but I, more supple to the inclinations of my fellow countrymen, am unwilling

to unbend the crooked finger, or straighten the almost distorted joint, inured to tally with the stroke of its accustomed trade, and at his old age deprive him of the art of his employment, and leave him in his second childhood to begin the world again ; and as the land carriage is chiefly carried on from trading towns and their neighbourhood, I must advance a very uncommon alterative, which would free the carrier from any fear of losing his employment, or selling off his stock of horses, viz. That no main trunk of a navigable canal ought reasonably to be carried nearer than within four miles of any great trading or manufacturing town, considering the present state and situation of affairs, and the propriety of blending the landed with the commercial interests ; which distance from the canal is sufficient to maintain the same number of carriers, and employ almost the same number of horses as usual, to convey the goods down to the canal, in order to go to the sea-ports for exportation. When any person forms a project for the general advantage of the nation, he should also consider that of every individual, and be careful that one is not burthened in order to unburthen another. I therefore have made this uncommon proposal, to favour the landed as well as the commercial interests ; for I think it certain, considering both interests together, that it is not for the benefit of every individual in a trading city, to have the navigable canal come close to their town, but that the same should be at a proper distance, about four miles ; so that each trade may still have some employ, those that carry the goods and merchandize, as well as those who manufacture them. There is no doubt but the person who manufactures the goods might afford to export them to foreign markets much cheaper, by having the navigable canal come close to him : but then we must consider all parties when we talk of trade, and not let the carriers starve while the traders and manufacturers ride in their coaches and fix, exulting over their dejected and distressed brethren and fellow creatures. If a manufacturer can have a certain conveniency of sending his goods by water carriage within four miles of his own home, surely that is sufficient, and profit enough, considering that other people must thrive as well as himself ; and a proportion
of

of profit to each trade should be the biasing and leading policy of this nation.

“ It has been often objected, that an inland navigation destroys that noble breed of draught horses, since there will be little or no occasion for them ; and upon that account that the farmers would not be able to sell their oats: and it has as often been pleaded in excuse, that the farmer might then turn his oat ground into wheat ground, and instead of so much land being employed to furnish food for a thousand horses, the same land, when turned into tillage fit to sow wheat upon, might produce sufficient bread corn to feed two thousand poor families. I have not leisure here to discuss each point so fully as I could wish, therefore, as I have before explained the commercial and landed interest in a medium way, I will rest this debate upon the merits of the former clause.

“ There certainly is nothing which requires the attention of the people of this nation more than the progress of husbandry, and in attending to that we cannot have too great a regard to the interest of the farmer ; and to ease him as much as we can in the burthens and hardships he undergoes, which are such as even to reduce him to support himself and family upon skimmed milk, whilst he saves the cream for the rest of his fellow creatures, and disperses it abroad in the nation to the nourishment of thousands. What great advantages will he not receive from these canals by being able to sell his corn, and carry it to any market at any time of the year ; and as the plenty of corn in this kingdom, and the easy conveyance of it from one place to another is what will make a greater equality through the whole kingdom ; and when it is cheap at home, he will be able to get a better price by conveying it to another market ; and if it should happen to be dear, any quantity might soon be brought from another country to supply their wants, by which means it would always keep at a medium price, the

R

whole

whole communication through, or in any place within twenty miles to the canal. It would then be an uncommon thing to hear of a riot on account of the dearness of corn. And I cannot help observing, that if corn and provisions are cheap, the manufacturers might be able to work cheaper; and in so doing might always keep up a good export to foreign markets, in being able to undersell other nations, and at all times to have a market (on account of the merchandize being sold cheaper) at foreign ports in preference to other nations.

“ The exportation of corn encourages the growth of it, and is one main branch of the trade of this nation, and ought to be countenanced, I mean in a proper degree, and bear a proportion in the exports, according to the price or scarcity of it. Whilst corn on an average is not more than five shillings and six-pence a bushel let the exports be uninterrupted; but when it advances higher than six shillings, it is time then to stop it in a proportionate degree. I hope, when I say it is a branch of our trade, that the sum of seven millions and a half of money, which, from the year 1746 to 1750 inclusive, was returned to this kingdom for five millions of quarters of grain exported (as appears from an account laid before the house of commons in 1751), will be a proof of its importance. Surely this well deserves some attention as a main branch of our trade, and such a one, that under the present happy government will always increase instead of diminishing, as the basis of that trade is the yearly product of our lands, and the materials all within ourselves; and whilst agriculture is daily improving, and the quantity of tilled land (from the inclosing of commons) is daily increasing, this seems our natural trade, and all others appear as grafted here from a foreign soil, and sometimes are too subject to canker at the root. How great will be the increase of the exportation of corn from these inland canals, when every farmer in the adjacent counties can almost, as it were, ship his corn from his own barn, and receive all the profits that the factor had used to have from the merchant himself! I will now
endeavour

endeavour to shew how much he will be a gainer by this convenience. Let us suppose, that a farmer in Staffordshire (from whence immense quantities of corn are carried to Woor or Sandbach by land carriage, in order to go to Manchester for home consumption, and to Liverpool for exportation) carries, for instance, one ton of corn, which he has agreed with his factor to deliver at Woor or Sandbach in Cheshire: the charges of his team, and himself and man, going fourteen miles, will not be so little as twenty shillings, as he must be out two days, when he might send the same quantity of corn in a boat of his own at one shilling and six-pence a ton for each ten miles; so that it would not cost him, charges included, more than five shillings: but if he should pay freight, it might be about one shilling and six-pence for each ten miles, more than if he had a boat of his own. But I will go further, and say that he might deliver it at Liverpool himself at the same tonnage and freight, which would amount to a very trifling sum more, at which place he would receive all the profits that the factor used to monopolize by such conveyance. His horses may be then employed in improving his land by carrying marle and manure to it; and he might inclose and till more lands, which are now waste grounds and commons. How greatly would agriculture be improved, and the increase and produce of our land fulfil the proverb of returning tenfold, and the shepherd made happy by the increase of his sheep. I cannot omit mentioning, before I conclude the enumeration of these general advantages, that prodigious and immense convenience that the merchants at the three ports will receive from being able to send their merchandise by this canal from Bristol to Hull; which is, in fact, joining the east and west together. A merchant that trades from Bristol to the north-east parts of the globe, will send his goods by this canal to be shipped at Hull; and also a merchant at Hull trading to the south-west parts of the globe, will send them by the same canal to be shipped at Bristol; by which means they will both avoid that most tedious and hazardous voyage of two months round the land's end, and also the expence attending those dangerous voyages, and find themselves considerable gainers.

“ I must here observe one very great and material advantage that inland navigation is of in keeping, through a whole country, an equimmediate price of provisions ; for when any commodity is cheap at home, it may be carried to a more populous part to get a proper price for it ; and when it is dear at home, it may be fetched from a cheaper market, and the poor will never be so liable to suffer by monopolize.

“ The great advantage that this kingdom will derive from a less number of horses being kept for draft is prodigious, as the same lands that kept twenty thousand horses, will now perhaps keep thirty thousand fat oxen ; by which means butcher's meat will be always cheap to the labouring poor, and the quantity of fat from so many beasts will of course make candles cheap : and so many hides lower the price of leather, and if so, of shoes and all other things made of leather. Or the same quantity of land may then keep thirty thousand cows, the milk of which will make both butter and cheese cheaper to the poor, as well as to the labouring manufacturer ; all which articles are very considerable, and of material moment in the price of our manufactures, as they in a great measure work their trade to rise and fall in price, according to the cheapness of their materials and the necessaries of life.

“ Inland navigation will encourage old manufacturers to work with fresh vigour when they can obtain their materials cheap ; and will give opportunity to set up new trades and manufactures, as the materials may be conveyed to any part of the country whatever.

“ There are many large mines of valuable contents, that for want of carriage and conveyance are now useless ; such as stone, iron ore, marble, and quarries of various sorts, that would then be opened and worked, and be productive perhaps of the greatest advantages to the proprietor, as well as to the various parts of the kingdom, in which they might be purchased at an easy rate.

“ The

“ The coasting trade seems to claim mention of the great advantages that will accrue to it by these navigable canals, as all or most of the goods that have usually gone by land carriage from London to these countries, will now be sent by shipping to the ports, and from thence be dispersed far and wide by means of these navigable canals : for the more you open a channel, the more water is drawn from the head, and consequently works its way farther on.

“ They will certainly cause more shipping to be employed on the coasts, and more failors to navigate them. I must here make one observation, that old men and worn-out failors may be employed on these navigable canals ; and those whose constitution will not suffer them to undergo the hardships and feverities of a sea voyage, yet may do very well to navigate these vessels on the canal : Every boy in each village through which the canals pass will have a desire to become a failor, and will be trained up in his early youth to hand a rope, and soon be fit to be of service on board a ship ; by which means these canals will become one of the most natural nurseries for seamen for his majesty's fleets, and the protection of this island ; as also of shipwrights upon any emergency : both which are certainly great advantages to any state.

“ These canals will be of great advantage to the landed estates, as more persons will now come and settle themselves on many commons adjacent to the navigation, for the benefit and conveniency of trade, and thereby improve and inclose those barren lands ; and the present inclosed lands will reap great benefit, either by draining some that want it, or flooding others, which is reckoned a great improvement to meadow lands.

“ I think the result of every plan and scheme for the public service should ultimately terminate in giving assistance to the distressed of the poor,

poor, and relieving their wants, by letting them have the necessaries of life at a cheap rate. This I term charity to our brother. This is the stamina of our trade, and a principal security for our present and future affluence.

“ It is as impossible that the immense advantages that will accrue to this nation, in a variety of instances from inland navigation, should be enumerated by one pen, as it is to number the sands on the shore; I shall therefore proceed to point out some local advantages to the manufactures only, bordering on these canals.

“ I will begin with the country about Tern-bridge, in the county of Salop, as the canal begins there at Severn. The amazing number of large iron works within four or five miles of that place, and all the way to Batchacre Grange, are astonishing. There are five large furnaces, viz. Coalbrook Dale, Madely Wood, Lightmore, Horsehay, and Ketley, which are computed to turn at least eighty thousand pounds a year each; and nine large forges, which may be computed to turn twelve thousand pounds a year each per ann. viz. Keinton, Tiberton, Upton under Haghmon, Withiford, Moreton, Pitchford, Sutton, Longnor, and Sambrook. There are several other iron, coal, and lime works, and large manufactories in the neighbourhood of the rivers Tern and Severn, that will border or lie within four miles of this intended navigation. There are also on the Cheshire side, lying on or near the river Sow, two more furnaces, viz. Madeley and Doddington, which may be computed as above; and four forges, viz. Lea, Winnington, Norton, and Warmingham, to be computed as above, besides many other large iron and coal works, and other manufactories.

“ As the great iron trade here carried on is but little known in other countries, I will proceed to shew what weight of carriage, and number of tons of materials used in that branch alone comes in and goes

goes out. As I collected my information from a master of one of the iron works, I hope it will appear that I have considerably under done it rather than over done it. I shall, therefore, next shew the number of tons coming in weekly and yearly, and going out.

Six furnaces, computed to turn yearly each - - £.80,000

Two ditto omitted.

Twelve large iron forges, computed to turn yearly each - 12,000

Two ditto omitted.

£.624,000

The weekly consumption of the six furnaces and twelve forges before-mentioned, is on a medium,

Tons of ore brought in, and pig iron - - 467

Ditto of iron manufactured going out weekly - - 252

Ditto of pit coal used weekly - - 237

Ditto of charcoal used weekly. - - 59

The above totals, multiplied by 52, make the yearly consumption as follows :

Tons yearly brought into the above furnaces and forges - 24,284

Ditto yearly going out manufactured - - 13,104

Ditto yearly consumption of pit coals - - 12,324

Ditto yearly consumption of charcoal - - 3,068

N. B. There are many more iron works that lie within distance.

Total

	Tons.	
Total amount yearly of tons	-	52,780
Reckoning on an average at 15s. per ton, the present price of land carriage costs yearly	- - - - -	£.39,585
Deduct for home carriage of pit coal for Salop furnaces	- - - - -	9,360 7,020
		43,420 32,565

So that the sum of 32,565 l. is the present price of land carriage yearly to these iron works alone; out of which we will allow 5s. per ton for land and water carriage at 1s. 6d. per ton for each ten miles on the canal, and the remaining 2s. per ton for land carriage, any where within six miles of the canal; so that it will stand at 10s. per ton, which amounts to 21,710 l. for the money saved yearly to these iron works alone by this canal, supposing the whole of the same conveyed upon it.

“ We must observe, that the foregoing calculation is made within a circle of twenty miles. They frequently send iron to Burton by Ivefey Bank, which might be sent by these canals; and also to Chester, and many other places at a very great distance. By lowering this heavy charge of carriage, the iron masters will be able to afford to manufacture their iron much cheaper, and consequently be able to under sell any foreign markets, or any iron that shall be imported; and in a few years will prevent the use of it, by being able to sell at a lower price than foreign can be sold at. As long as iron takes a price it will always be imported, and whatever iron comes to a sea port, whilst your home-made iron is at a high price, will always work itself into the heart of the kingdom, let the passage or conveyance be as difficult as it will; but when once your materials come cheaper to you to manufacture

ture your iron with you, you will be able to sell cheaper, and by that means only will prevent the importation of foreign iron.

“Cumberland ore alone is a very important article, which will entirely be conveyed along this canal from Frodsham in Cheshire: a very small furnace will use at least one thousand one hundred tons of it in a year, which comes now entirely by land carriage from Winsford-bridge, in the county of Chester, at six shillings per ton for a very small distance, which may be conveyed by these canals to all or most of the furnaces and forges. If Liverpool and Hull should ever have a separate navigation, they will send foreign iron into those countries, which these iron works, I now have been speaking of, used to supply. I have therefore proposed this plan for the junction of the three ports at the same time, otherwise the iron masters about Severn in Shropshire would have no opportunity of such easy conveyance, and consequently lose the market, and must of necessity decrease their sale, and greatly injure their works. I have dwelt thus long upon the iron trade, to shew that no branch of manufacture can reap more immediate benefit from the making of these canals for inland navigation, or more sensibly feel the want of them, when other parts of the kingdom have them.

“The next article of trade is the immense number of great coal works that lie bordering upon this canal in Shropshire, Staffordshire, and Cheshire. I will first mention those at Ketley in Shropshire; from which many thousand tons of coal are conveyed yearly to Shrewsbury by land carriage, which might be sent by water. There are very great lime works nigh this canal, belonging to Brook Forrester, Esq. at Steeraway. The tons of lime got yearly may be about twenty thousand, used for manure of land and for building. The yearly demand is very large; ten thousand tons of which might be carried by water. About Newport, at Linsell, are very large coal and lime works, belonging to Earl Gower, and others, the produce of which is very great, being

S

computed

computed yearly at thirty-five thousand tons of coals, and thirty-five thousand tons of lime; ten thousand tons of each of which might be conveyed to all the north, east, and west part of these countries, and might almost be delivered into the boats at the works, as a canal might very easily be made at the bottom of the hill by Chesul Grange, to unite with this canal a little below. The whole of the land to be cut through, being his Lordship's property, and if his Lordship did not choose to do it, the proprietors would gladly undertake it. The towns of Eccleshall and Stafford, and the countries between, might be supplied at a cheap rate, and firing come more reasonable to poor people. There are likewise several large coal works about Madeley Park, viz. Leyfit, Scotthay, and others, belonging to Sir Nigel Griesly, Mr. Crew, Mr. Meynell, and Mr. Pool. There is also lime stone at Bishops Offley, in the parish of Adbaston, but which, for want of coals to burn it with, is made no use of. There are also other large coal works in Cheshire, that go by various names, which supply the furnaces there, and also the town of Nantwich, Betley, and all the neighbourhood. Nantwich alone, in its present state, may be computed to use twelve thousand tons, and its neighbourhood to Winsford, about fifteen thousand, which might be conveyed along this canal from Modeley pits in Staffordshire; and instead of costing ten shillings per ton land carriage, would cost only one shilling and six-pence per ton, besides freight, which may be reckoned at as much more; so that the price of the article of coals alone will be decreased to the labouring poor, and to the consumer, seven shillings out of ten shillings, besides that they would be enabled to fetch them at all seasons of the year, let the roads be as bad as they might.

The next article that will prove the usefulness of these canals is the lime, which is used for the manure of land, and is a most excellent and quick improvement. It has hitherto been used only where the carriage comes easy; it will therefore now become general, and many lands that have never yet been improved by it, will quickly assume another appearance,

pearance, and demonstrate in the most satisfactory manner the great utility of an inland navigation to any country.

“ I cannot omit mentioning the great quantities of cheese that are yearly carried to Bridgenorth fair from most parts of Cheshire and Staffordshire: it is impossible to make an exact calculation, but suppose we may say a thousand tons from these parts, which are now carried by farmers' waggons for twenty or thirty miles, being obliged to stay out with their team, at a great expence, three or four days, perhaps at little less than thirty shillings, with two tons of cheese only, which might be conveyed by this canal for twenty miles: freight and tonnage for six shillings only, and from Tern-bridge to Bridgenorth, for three shillings more; so that we see in this article alone there is one pound one shilling saved, besides the work that the horses may do whilst at home four days. Surely, from this convenience the farmer can afford to part with his cheese much cheaper, and the poor may have provisions at a more moderate price.

“ The next manufacture that seems to claim our attention, with respect to diminishing the heavy burdens of land carriage, is the potteries of Burslem and Newcastle, great quantities of the manufacture of which are sent weekly from thence to Bridgenorth, through Eccleshall and Newport. There are constantly two, and sometimes three waggons which go every week to Bridgenorth, and usually carry about eight tons of pot ware, to be conveyed to Bristol by water; and their loading back usually consists of all sorts of grocery, foreign iron, and white clay for Burslem, to supply the inland towns of Newcastle, Stafford, Eccleshall, Newport, and many others, and the countries between. Sometimes they bring Worcestershire hops and cyder from thence. The back carriage of the iron and clay being heavy goods may be computed at ten tons per week. But as there is a great traffic carried on in the cyder and hops alone by farmers' waggons, which are hired on purpose to fetch them, I will therefore compute that two thousand tons of

S 2

hops

hops and cyder come yearly into these countries, and far beyond them into Cheshire; the whole of which might be conveyed by this canal, and thereby seven shillings per ton saved out of every ten shillings now paid for land carriage.

“ Large quantities of pot ware from Burslem are carried on horses’ backs in large crates to Bewdley and Bridgenorth, which might be entirely conveyed this way, and which may computed yearly at a hundred tons, at two shillings and ten-pence per ton, from Burslem to Bewdley, whence they are sent to Bristol for exportation.

“ I must not forget the number of pack horses, about one hundred and fifty, that go weekly with woollen cloth, and various other kinds of merchandize, for exportation, from Manchester, through Stafford to Bewdley and Bridgenorth, computed yearly at three hundred and twelve tons of carriage, which might be conveyed above one half of the way by water, from Manchester to Northwich by land carriage, and from Northwich by water to Bewdley or Bridgenorth, which would be nearly one hundred miles by water; by which easy carriage the merchants at Bristol would be able to export their merchandize much cheaper, and under sell any other merchants at a foreign market: the manufacturer would also reap his share of a profitable voyage, and by a quick return from the merchant would enliven his poor workmen, not only with prompt payment, but with future hopes of employment, by having his market as it were at hand.

“ There is a great trade carried on at Shrewsbury in coarse cloths and flannels, which come out of Wales, and supply a great part of Staffordshire and Shropshire bordering on the canal. These might then be conveyed by this canal to Liverpool to be exported, and may be computed yearly at one thousand tons, passing three score miles on it.

“ I cannot omit the great trade of salt that is carried on at North-
wich,

wich. The salt which can now only go to Liverpool by water, when this canal is made, may be conveyed at least one half to Bristol, and that made at Nantwich, which is now carried on horseback, and serves three or four inland counties, and of which the quantity may be computed at four hundred tons, may then entirely be conveyed by water to these three or four inland counties, thirty miles upon an average.

The great trade that Chester now enjoys from Ireland in cloths and linen, and which occasions so great a fair to be held there twice in a year, must, without doubt (whenever Chester shall have a canal to unite with this at or about Nantwich, which may easily be effected whenever the gentlemen of Chester shall think proper, at a very trifling expence), be conveyed from the fairs at Chester along this canal to Northwich, Nantwich, Eccleshall, Stafford, Newport, Drayton, Salop, Bridgenorth, and various other towns, and the intermediate countries. The tons of cloth and linen only that are likely to be conveyed along this canal, may be computed at two thousand yearly, forty miles upon an average, water carriage, on this canal.

The quantity of Cumberland red ore that is used at Doddington furnace in Cheshire, is about eleven hundred tons yearly. It is brought from Frodsham, over Delamere Forest, in carts, at a very great expence. Could the great furnaces at Ketley in Shropshire be supplied with this ore by water, the six furnaces there (which now buy Cumberland pig iron) would use twelve thousand tons or upwards to serve the forges, and the ore would be brought along this canal sixty miles at least.

The great quantities of fine hard brick fit for floors, and blue tiles that are sent for to Madeley Park from various parts of Staffordshire and Shropshire, and are conveyed at an immense expence by land carriage, may be computed at two hundred tons of bricks and tiles, that would be carried to all parts bordering on the canal. Let us suppose

pose a farmer goes ten miles for a load of tiles to Madeley, his waggon and two persons with it must be out two days, which will cost him more than twenty shillings. If he brings back a ton of tiles, as they seldom carry more on account of the badness of the roads to that place, he might convey the same for one shilling and six-pence tonnage (and one shilling and six-pence freight if he does not keep a boat of his own); so that he saves at least fifteen shillings, allowing two shillings per ton for land carriage from the water side to his house. This saving is only in ten miles, and will be doubled if he lives at the distance of twenty miles; and as he will be able to carry more tons at a load, he will make a considerable saving from that circumstance likewise, as a boat will bring thirty tons; so that in one day he may lay down bricks and tiles enough to build his house, and the next day may send his boat for a sufficient quantity of lime and other materials, instead of lingering and dragging out a whole summer, and perhaps some part of the winter in bringing his materials by land carriage.

I cannot omit mentioning once more the vast quantities of corn, and all sorts of grain from the counties of Stafford, Salop, and Chester, that will be sent to all parts along this canal, to supply home as well as foreign markets; and from these three counties bordering on or within six miles of the canal (being great corn countries) we may at least suppose fifteen thousand tons will be carried yearly twenty miles upon this canal, which, reckoning one shilling and six-pence tonnage, and one shilling and six-pence for twenty miles on this navigation, will amount to a very large income.

We can, at present, scarcely imagine the quantities of different kinds of merchandise that will come upon this canal: it is morally impossible to state them all. For as many different articles as are now made use of by man, so many different and various sorts of merchandise will be carried along this canal.

I will

I will only mention one more considerable article, which will always be conveyed along this canal. I mean the timber for houses, and also for ship-building, as within six miles of this canal, in Staffordshire and Shropshire, they may vie with all the rest of the kingdom (taking the same compass) for the largeness of the oak trees fit for keels and building large ships. These may be conveyed at least sixty miles upon this canal. We should give some sort of computation, what number of tons are now upon a medium yearly felled within six miles of each side of the canal, and in sixty miles length-ways, which, if conveyed to Liverpool or Bristol, may be supposed to pass upon an average thirty miles upon this navigation (at a mean from the centre). We will suppose ten thousand tons and upwards of house and ship timber, that will pass thirty miles on this navigation, which, at one shilling and six-pence per ton, will amount to two thousand two hundred and fifty three pounds: which will be an income that will accrue only between Bristol and Liverpool, but would be much greater if carried down to Hull.

I must here observe, that all the trade, manufactures, and merchandise I have hitherto mentioned, are subsisting between Liverpool and Bristol only. I have not yet touched upon or taken notice of any trade from Stafford down by Burton to Wilden Ferry, which is about forty-three miles. It is a very great country for timber, but there is no very great or considerable manufacture any where within six miles of the canal, except I am to mention the large quantity of fine Staffordshire ale that is brewed at Burton, and sent to all parts, carrying on a large trade in that commodity alone. A great quantity of malt would no doubt be carried along this canal, thirty or forty miles perhaps from the inland parts; but I greatly fear that the farmers would be so fond of carrying their malt in their own boats to Burton, that being pleased with the produce of their lands being liquidated into that fine amber colour that always appears in Burton ale, they would be apt to stay and consume the profits of the voyage in that bewitching liquor; so whether I can number it among the advantages to these countries, I cannot yet determine. However, the number of tons of malt that will be conveyed along
the

the canal on this account, at least twenty miles upon a mean, will turn out to increase the income of the canal. In case that Birmingham and Wolverhampton, Litchfield and Tamworth, should ever have cuts made to communicate with this canal," (which since the publication of the pamphlet from which these extracts are made has been accomplished) "the chief of the tonnage upon this part would accrue from various manufactured goods which they send abroad to be shipped at Hull. Birmingham might have a canal made to go by Litchfield, and fall in with this at Kings Bromley Common, which would be about twenty-four miles. Wolverhampton might have a cut, either down by the Penk river, to fall in at the junction of the Penk and Sow, or by Hedgeford Pool, down that valley, to fall in by a forge about Rudgeley; but which of these two is most feasible I cannot determine, the first being sixteen miles, and the falls very great; the latter about eighteen miles, and the falls by the Penk much less. The trade and manufactures from these places might then be conveyed along this canal to Burton and Wilden, and thence along the river Trent to Hull; but as these manufactured goods are what are called light goods (in comparison to pig iron and bars that are worked up in the furnaces and forges), and the quality much exceeding the quantity, I imagine they will not turn out so advantageous in the revenue from the tonnage as heavier commodities do, though they take the same quantity of water to go through the locks, and consequently ought to pay in proportion equal to the diminishing the water in the locks, but that I am afraid will never be the case. As their goods are chiefly polished and wrought iron, they may think that the damp that arises from fresh water may greatly injure the sale of them by creating rust and foiling the polished steel. Salt water has not that effect in so great a degree, though I believe they would sooner prefer land carriage for such goods, on this account, than water carriage. I cannot here number any part of this trade upon this canal, as it may perhaps never happen that they may have such a cut as I before have mentioned; and when they have, the weight or income from tonnage will be but trifling, as they can go only about thirty miles upon it before they get into the Trent at Wilden,

Wilden, and they will send no other goods along it but what are for exportation, and, as I said before, will turn out little to the income of the canal, being great in quality, but not in quantity; nor will it be a constant trade, only once or twice a year, when the merchant ships are ready for their voyage at Hull, as the manufacturer will send the produce of a whole year's work at once; nay, perhaps in so little compass as a small arms-chest, which may contain in nice polished ware six or seven thousand pounds worth, and perhaps would not pay to the tonnage of the canal above six shillings for the thirty miles upon it, as the goods at the utmost may not weigh above four tons.

“ I must here take notice how easy the canal between Tern-bridge and Batchacre Grange to Bridgeford will be completed, as no country can be more properly adapted for a navigation, being so well supplied with water, and a little below Batchacre Grange there is eight miles, and only eleven feet fall; so that there will be eight miles without a lock. As I have mentioned some few words about the size of the boats necessary for this canal, I must give some description of the size of the locks, the quantity of water they receive and discharge, and then shew the quantity of water in the reservoirs, and where those reservoirs are to be made, and how many boats that quantity of water will suffer to go through each lock in a day. The canal is proposed to be nine yards broad at the surface of the water, six yards broad at the bottom, and five feet deep in water: the sides will be an angle of about forty-five degrees. The boats are to be fifty feet along, and twelve feet broad, and will carry thirty tons, and will draw three feet water loaded, with one mast to lower down upon deck, a main-sail, fore-sail, and jib, and a spare square-sail to hoist up before the wind: decked from stem to stern, or as occasion may require. One horse will draw these vessels at the rate of five or six miles an hour, and they will bear the tides way either to Bristol, Liverpool, or Hull, which saves them the trouble of re-shipping.

“ The locks are to be ten feet high, sixty feet long, and thirteen feet broad : the surface of water running in each time the lock is opened, will be the height of the lock, which will be ten feet deep ; so that the waste of water amounts at the locks to 288,8 cubic yards or 200 tons of water, the keel excepted.

“ Now we are to see how many times that quantity is contained in the reservoirs ; and the summit is the first place to be considered, which is in the valley below Offley Park. There is now a large reservoir of water at Offley Park mills, which may be made twelve acres surface, and ten feet deep, which will contain 193580,6 cubic yards. There is also a large sheet of water called Cockmere, thirty-five acres, which may be pounded up ten feet higher, and make a larger sheet, both which would amply supply the west course, as at Batchacre Grange you have a reservoir of eighty acres of water, which, at five feet deep, contains 645074 cubic yards ; on the sides of which the intended canal is to go, which, without further supply, would be sufficient for the locks as far as Severn, and suffer a vessel to pass through the locks fifty-six times each day. Numbers of brooks and rivers may be pounded up any where the whole way down to Tern-bridge on the Severn. There is no country so well supplied with water for frequent passage as this between Tern-bridge and Bridgeford. We will now shew how the east course may be supplied, viz. from the summit below Offley Park to Bridgeford. Opposite almost to Offley Park is Cockmere, a large water of thirty-five acres, which is now higher than the summit of the canal, and may be pounded up to any height ; a yard or two without any damage, as the banks on each side are very high, and the valley above very quick in the descent and narrow ; so that the expence of having a surface of water of thirty-five acres, and ten feet deep, which would contain 564610,2 cubic yards of water, and fill the locks 1950 times, would be very small. Many places all the way down to Bridgeford might be made for very large reservoirs, which would supply the locks down by the Trent to Wilden Ferry, at no very great charge or trouble. We will

next consider what quantity of water we shall have to supply the north-west course of the canal, between the summit at Madeley Park and Winsford-bridge; and therefore observe, that a large sheet of water of forty acres, and five feet deep at a mean, which will contain $322537 \frac{1}{2}$ cubic yards of water, may be made above the summit in Madeley Park, at Madeley manor house, which will supply the north-west course, and suffer 1119 boats to pass each forty days. As the current coming in, taking the summer through, will be able in that time to fill the same again, the head of this rivulet here would be sufficient for such supply at any time, and suffer about twenty-eight boats to pass each day. The rivulet that rises in the Can Bogs in Madeley Park, by making a dam at Charlton, would be easily made to supply the south-east course to Bridgeford.

“ I must here observe, that the reservoir at Madeley Park will be full as lavish of its waters, and will be able to supply as quick a passage as that from Offley Park summit to Tern-bridge or Bridgeford.

“ The great matter is to have water at the head or summit of your canal sufficient for a quick passage: since if that is wanting your navigation will soon stop and become useless.

“ Now I have made mention of the canal at Tern, I will make a few remarks upon the navigation of that part of the river Severn, from Tern-bridge down to Redstone Ferry, which is about thirty-three miles; and as the difficulties of the shallows or fords attending that navigation are made a great deal worse than they really are, by reports maliciously spread by evil minded persons, it will therefore be necessary first to premise what they are in reality, and then to propose an easy method to obviate and remove such difficulties, by deepening the shallow fords at a small expence. There is no river that has such a length of navigation (in England) as the Severn: you may navigate a vessel of fifty tons, and not a lock the whole way, two hundred miles up to Welch Pool,

except in an excessive drought, which does not happen every year, and, when it does, never lasts at the longest above a month or two; but upon a small quantity of rain falling will give water sufficient. There are some few fords or shallows between Tern-bridge and Salop, but these may be very easily remedied. Between Tern-bridge and Bridgenorth, which is fourteen miles, there are in a very dry summer several shallows that go by various names; but at any of which a well constructed vessel, carrying thirty tons, is seldom or never impeded, except at the three following, viz. the Lake, the Worps, and the Lydes. They lie all within the compass of a mile, and when the vessels come there, they take out two tons or thereabouts to lighten them, and put them into smaller boats, and re-ship the same again in about a mile, without any additional expence to the person who sends the goods. These fords are partly opposite to Madeley wood: They are about half an hour unshipping the goods, and about as much time in re-shipping. Between Bridgenorth and Bewdley are also fords or shallows; but they impede vessels of that burden in a very trifling degree, except two shallows nigh to Bewdley. Below Bewdley to Redstone Ferry are two more shallows, as bad as any of the above between Tern-bridge and Bridgenorth.

“ The reader must be informed, that the lowest water that ever happens in the driest summer is never less than eighteen inches, which is sufficient to carry vessels of sixteen or seventeen tons burthen at any time.

“ The river Severn is a free navigation, and no tonnage upon it, and the number of persons navigating upon it live at various places, and are not connected in a body sufficient to agree to remove these shallows, or to apply to parliament for an incorporation for such a purpose; and as the old phrase is, What is every body's business is no body's; therefore the reader must not be surpris'd why these shallows have not been remedied hitherto: nor let him be more astonish'd, when he is informed that every and each of these shallows may be remedied and deepened,

deepened, so as to admit vessels of fifty tons burthen, in the driest summers, for the trifling sum of forty pounds each; but, as I said before, what is every body's business is nobody's: so the thing has hitherto been neglected. I would therefore propose, that the proprietors of the Tern-bridge navigation here intended, should have a power vested in them to lay out any sum not exceeding one thousand pounds upon the river Severn, from Shrewsbury to Worcester, in order to make the navigation of the Severn more commodious by deepening, scouring, and widening the said the river or the banks thereof, or by any other method or contrivance, making and rendering the said navigation more complete and perfect. As also a power should be given by act of parliament for the towing, hauling, and drawing of vessels and other boats, by horses as well as men on both sides of the river Severn. If the above requisites should ever be obtained, the Severn would then be called the most complete navigation in all the kingdom.

“ Though in the former part of this treatise I have chalked out a method, whereby this intended scheme may be executed, and have proposed the same to be done by a company of proprietors; yet I cannot help thinking, and strongly recommending, that the government should undertake a thing of such immense and material consequence to this nation, as the joining the three great ports of Bristol, Liverpool, and Hull together by a navigable canal, as it ought to be executed in a noble manner, and not intrusted to the interested and narrow-minded notions of the upstarts of every little trading town, whose sole view will be their own good at the costs of others. The design is great, and it were to be wished the execution was so that such a canal may be made of a size, width, and depth as will admit at all times such vessels as will bear the navigating through the tides way in the channel; and all things attending the execution of this design should be of a piece one with another. It would be proper if the government were to stay the petitions of private people, and take a summer or more to consider and find

find out which is the most proper part of the country to carry these communications through, not regarding in the least any populous trading town ; but they should find out that course which would afford at the summits the most ample supply of water in a dry summer, as this is the chief article upon which the good or evil of such navigation depends ; for as there must naturally be a high summit of land between each junction, from whence the water runs both ways, which, unless there is an ample supply of water for the filling the two upper locks a number of times each day, in order to admit the passage of as many boats, it is in vain to propose the navigation that way ; for every time a boat passes a summit lock, there will be required a supply of five hundred and seventy-six cubic yards of water : so, as many times each day as the current will be able to supply that demand, so many vessels may have water to pass. It should, therefore, upon this account be wished, that this material point may be well considered ; for if the water in these main trunks should fail, there is an end of the navigation. The proper course of such supply ought first to be found out, not regarding, as I said before, any particular populous town or manufacture whatsoever, as it would be the most proper for the trading and manufacturing places to have canals cut into the main trunk from each place or town. Many inconsiderate people will object and say, that it is of no use unless it comes by the trading towns. It should readily be granted, that it would be convenient that the main trunks should go by those places, provided such towns happened to be situated in a country that would afford the most ample supply of water ; but for this small trifling convenience to one town, surely the main communications between the three ports are not to be destroyed. Let all trading towns have canals cut into the main trunks : for if the main trunks want water the whole navigation is impeded. Some inconsiderate people may make use of an argument, and ask whether the Thames navigation coming close to London does it any harm ? They will be pleased to consider, that London was situated for the convenience of the navigation, and was built after it ; and that there is a great difference between a town built upon
a navigable

a navigable river, and a navigable river being brought to a town; the former having suited all their employments and trades accordingly at their first coming: when perhaps in the latter the whole face of the landed trade is to be changed, and the number of families that have hitherto supported themselves by land carriage would be totally deprived of bread; and many other trades undergo an entire transmutation. One may therefore repeat the wish that the government would undertake the execution of the main trunks, and carry them through such part of the country as will afford the most ample supply of water at the summits; and that the private canals from each trading town or place may be executed in the manner most interesting and satisfactory to the inhabitants, at their own costs and charges, and under their own directions.

“ I have also, in the former part of this treatise (continues my author) described the canal as proper to be carried down to Wilden in Derbyshire, yet upon mature consideration, and having informed myself of many difficulties that may arise on account of the floods from the river Dove, which would greatly impede the execution of the navigation, by being obliged to raise a high bank along the meadows for almost three miles, with arches every hundred yards to suffer the floods from the river Dove to pass through; I am, for these and many other reasons, inclined to think that the canal ought to enter the Trent at Burton, as there is a navigation already made by authority of parliament, and which is reported to be no very bad one. It is granted to the Earl of Uxbridge, and is now enjoyed by his lessees. The tonnage is very reasonable, and large vessels may navigate upon it. From Burton to Wilden is nearly sixteen miles, and the water in the river Trent is deeper from Burton to Wilden, than it is below Wilden to Gainsborough, as there are more shallows in proportion below Wilden Ferry to Gainsborough than between Burton and Wilden (this I shall explain further on at a proper time). Between the latter, vessels from thirty to forty tons may navigate, which are seldom or never impeded. From Burton to Gainsborough is about one hundred and ten miles, and boats are frequently

quently known to perform that voyage, and back to Burton in eight days. Tonnage upon the Burton navigation is very moderate; nor can it be considered in any shape as a monopoly, as the tonnage of that river from Burton to Wilden is no more than three-pence. From these, and several other arguments, I am induced to think that it would save a considerable sum of money, by having the canal to enter at Burton, I dare say at least ten thousand pounds to the proprietors; but as I have chalked out the other, I must leave it to the consideration of those concerned. But in case the canal should be made as far as Wilden, I think at least that the proprietors who have been at the expence of the Burton navigation, should have as many shares in it as their present debt amounts to, or in some measure that part of the tolls arising from the same length of the canal, as is opposite to their navigation, should be appropriated for the payment of the principal or debt lodged upon the old navigation. I must however continue to think, that it would be no great detriment to the public were the canal to terminate at Burton: and for my own part would rather wish it, provided the same was to be put under the same directions, regulations, and orders, as by authority of act of parliament the present canal is intended to be; and that the present lessees, when under such restrictions, might be concerned as proprietors in the same.

“ It is not requisite to my present purpose, that I should enter into the minutia of every article in the succeeding table; most of which have been before mentioned, either as produce, manufactures, or commerce. I shall now shew the gross sum the canal will produce, all expences paid.

“ It will appear, when all circumstances are duly considered, that the income of fifteen thousand two hundred eighty-five pounds eighteen shillings, which is computed as accruing to the proprietors of the navigation, is, in fact, only a third of the real profits from the tonnage of goods; but as it serves the purpose of proving, that the income of this canal

canal will pay the expence of making it in a few years after it is completed, and of shewing to the parliament, that the taking the same into consideration is worthy the notice of the legislature to pass an act for that purpose as a public good, and not only a local but a national benefit.

“ I will now proceed to shew what sum of money the proprietors will be enabled to borrow, paying five per cent. for the same from the time the sums are wanted, for the execution of the design. The income (being only estimated as a third part of the really expected profits) amounts to the sum of fifteen thousand two hundred eighty-five pounds eighteen shillings, which will enable them to borrow the sum of three hundred thousand pounds, leaving the sum of two hundred and eighty-five pounds eighteen shillings for repair of locks, and other accidents, and salaries to officers and servants; but if the income should in a few years amount to forty-five thousand eight hundred fifty-seven pounds fourteen shillings, it will enable them to borrow the sum of nine hundred thousand pounds, leaving the eight hundred fifty-seven pounds fourteen shillings for repairs of locks and salaries to officers and servants. We will now come to the estimate of the expence of making and completing the canal; and as I have before only reckoned the income as chiefly accruing between Bristol and Liverpool, and very little on the part of the canal leading to Burton and Wilden Ferry, I will therefore first mention the sum that will be required for making and completing the canal from Tern-bridge, on the Severn, by Batchacre Grange to Bridgeford in the county of Stafford, from thence by Madeley Park in the said county, to Winsford-bridge in the county of Chester, to communicate from thence with the river Mersey by the river Wever.

“ The sum required will amount to sixty-eight thousand pounds, including all things during the execution of the work; the interest of

part of which must be paid out of the fund until profits accrue, which may happen in less than three years sufficient to pay the whole interest, and replace the deduction out of the principal; and as the canal may be completed in four or five years between Bristol and Liverpool, the principal in six years after might be paid off, and twenty-two thousand pounds over the last year to pay off the interest of the sum in hand, each year decreasing gradually for six years, the account will stand thus:

“The certain income of the canal is fifteen thousand two hundred eighty-five pounds eighteen shillings, which, at five per cent. enables them to borrow in the whole three hundred thousand pounds.

“The expence of making the canal from Tern-bridge to Winsford-bridge, sixty-eight thousand pounds; so that if the proprietors only borrow sixty-eight thousand pounds, the interest required to pay for that sum will be three thousand four hundred pounds, there remain then eleven thousand six hundred pounds to be divided among the proprietors yearly (over and above the five per cent.) as profits accruing from the canal, which, if the law would allow me to term it so, would be an income of upwards of twenty pounds per cent. to each proprietor, exclusive of the two hundred eighty-five pounds eighteen shillings, which is allowed for unforeseen accidents, and yearly salaries to officers and servants. Surely all persons will be induced, that have any sense of their own welfare, to lodge their money in this fund, not only in order to lend their assistance to so public a good, but for the satisfaction of receiving twenty pounds yearly for each hundred pounds so lent, and the principal to be paid off in a few years, or at any time they choose it, and thereby securing a certain annual large estate for themselves, and their heirs and assigns for ever; and let each person consider, that in ten or twelve years the income may amount to forty-five thousand pounds per annum and upwards. How great and im-

mense

menſe will be the profits accruing to the proprietors ! They muſt be ſuch as to make every one repent that he had not the foreſight and prudence to lodge his whole fortune in ſo glorious an undertaking.

“ I will now proceed to ſhew the expence of making and completing that part of the canal from Bridgeford, in the county of Stafford, by Stafford, Woleſly-bridge, and Biſhton, in the ſaid county ; thence by Burton to Wilden Ferry, on the river Trent, in the county of Derby, being one fall from Bridgeford, ſouth-eaſtward to Wilden Ferry. The income of that part of the canal (which I muſt term the eaſtern branch) is not very conſiderable, but will chiefly ariſe from the carriage of corn and all ſorts of grain towards Wilden Ferry ; and the carriage from Wilden back will be ſomewhat conſiderable in London goods brought to Hull by ſea, and thence along this cut to the inland towns eaſt of Stafford, being not many in number, as moſt of the country about Stafford will be ſupplied from Briſtol or Liverpool. The diſtance from Bridgeford to Wilden Ferry is forty-three miles ; and the income to the proprietors may every year amount to the ſum of two thouſand ſix hundred and ſeventeen pounds ten ſhillings for tonnage of goods paſſing on the canal : the proprietors will therefore be enabled to borrow at five per cent. as before-mentioned, the ſum of fifty-two thouſand three hundred fifty pounds ; and the eſtimate of the expence of making and completing the ſaid eaſtern branch will amount to the ſum of forty-eight thouſand pounds, including the things neceſſary. So that if the proprietors borrow the ſaid ſum of fifty-two thouſand three hundred and fifty pounds, the intereſt will amount at five per cent. to two thouſand four hundred pounds, and there will remain the ſum of two hundred ſeventeen pounds ten ſhillings to be divided among the proprietors as the profits of the canal ; and if the law would allow me the appellation, would be more than an income of five per cent. per annum. I muſt alſo add, that this income will greatly and immenſely increaſe whenever Wolverhampton and Birmingham ſhall have cuts into it as before deſcribed (which is now completed).

" I have now shewn the profits arising and accruing on each part of this canal, and for the distinction of each part should choose to divide them into three districts, reckoning the junction of the river Sow, above Bridgeford, in the county of Stafford, as the centre where they all unite. The first district from the junction above Bridgeford, in the county of Stafford, to Tern-bridge, should be termed the western district, which is thirty miles and a quarter. From Bridgeford afore said to Winsford-bridge, the second district, which should be termed the northern district, and is thirty-two miles three quarters. From above Bridgeford afore said, by Burton to Wilden Ferry, being the third district, should be termed the eastern district, which is forty-three miles; in all one hundred and six miles.

"The Estimate of making the Canal from or near Tern-Bridge, on the River Severn, in the County of Salop, to the Junction at Bridgeford-Bridge, in the County of Stafford: The Distance being Thirty-one Miles and a Quarter. Rise One Hundred Thirty-six Feet Nine Inches to the Summit. Fall to Bridgeford-Bridge Fifty-four Feet Eight Inches.

IN the intended course of this canal, between the upper end of Tunstall Moors (in the valley below Offley Park), and its junction with a brook near to Cockmere: the distance being a mile and a half: the highest point of land being an elevation of twenty-five feet. To reduce this to a level eighteen yards in breadth (being the breadth of the canal, towing-path, and drains) must be removed at a mean 198015,84 cubic yards, which, at three-pence per yard, will amount to

£. s. d.

2,475 3 11½

The canal is proposed to be nine yards broad at the surface of the water, and six yards broad at the bottom. These dimensions, in thirty-one miles and a quarter, will produce 687637,5 cubic yards, to be removed, which, at three-pence per yard, will amount to

8,595 9 4½

The canal, towing-paths, and drains, being eighteen yards in breadth, in thirty-one miles and a quarter (deducting one mile for waste land), there will be one hundred and ninety-nine acres, one rood, and twenty perches: to purchase which, at 15l. per acre at a mean, will amount to

2,985 0 0

Twenty road bridges, at 80l. each, will be

1,600 0 0

Fifteen water bridges, at 50l. each, will be

750 0 0

Making

£. s. d.

‘ Making towing-paths, drains, gates, and fencing,
at 10l. per mile, will amount to — — 312 10 0

From the highest point of land below Offley Park
to the river Severn (the fall being one hundred thirty-
six feet nine inches), supposing a lock necessary for
every fall of ten feet, thirteen locks at least will be re-
quired, which, at 450l. per lock, will amount to 5,850 0 0

From the said highest point to Bridgeford-bridge (the
falls being fifty-four feet eight inches), in the above-
mentioned proportion, there must be at least five locks,
at 450l. each, will amount to — — 2,250 0 0

Two funnels between each lock, making thirty-
four in number, at 10l. each. will amount to — — 340 0 0

Five per cent. upon the whole for unforeseen ac-
cidents — — 1,414 3 0

£. 26,572 6 4

To make the three shallows between Tern-bridge
and Redstone Ferry, and the two below on the river
Severn, to a proper depth of water fit to carry a vessel
of thirty tons, in the driest summers, at 40l. each,
amounts to — — 200 0 0

N. B. Eighteen inches water is the lowest ever known to be in the
greatest drought (which will always carry a vessel of twelve or fourteen
tons). This continues for three or four days, till rain comes; so that
the alteration or deepening the fords as above will be necessary.

“ The

"The Estimate of the Expence of making the Canal from the Junction above Bridgeford-Bridge, in the County of Stafford, to Winsford-Bridge, in the County of Chester. The Distance Thirty-two Miles and Three Quarters. Rise to the Summit One Hundred Feet Three Inches and a Quarter. Reduced Fall to Winsford-Bridge, Two Hundred and Eighty-four Feet One Inch.

IN the intended course of this canal, between the lower end of Charlton Moss, and about half a mile below Snape, the distance being one mile and half, the highest summit of land is an elevation of twenty-five feet. To reduce this to a level, eighteen yards in breadth, the breadth of the canal, towing-paths, and drains, must be removed at a mean 1980158,4 cubic yards, which, at three-pence per yard, amounts to

£. s. d.

2,475 3 11½

The canal is proposed to be nine yards broad at the surface of the water, and six at the bottom, and five feet deep. These dimensions, in thirty-two miles and three quarters, will produce 72011,8 cubic yards of earth to be removed, which, at three-pence per yard, will cost

9,002 13 0

The canal, towing-paths, and drains, being eighteen yards, at thirty-two miles and three quarters, there will be to be purchased 214 acres, which, at twenty pounds an acre, will amount to

4,287 5 2½

Twenty-two road bridges, at eighty pounds each,

1,760 0 0

Three water bridges, at fifty pounds each,

150 0 0

Making

	£.	s.	d.
Making towing-paths, back-drains, gates, and fencing, at ten pounds per mile	330	0	0

From the junction above Bridgeford, to the summit in Madeley Park, one hundred feet three inches and a quarter, supposing a lock at every ten feet necessary, it will require ten locks, at 450l. each,

4,500	0	0
-------	---	---

From the above summit to Winsford-bridge, two hundred and eighty-four feet one inch fall; and supposing a lock necessary for every ten feet fall, it will require twenty-eight locks, at 450l. each,

12,600	0	0
--------	---	---

Two funnels between each lock, will be seventy-six, at ten pounds each,

760	0	0
-----	---	---

Five per cent. upon the whole for unforeseen accidents

1,793	5	0
-------	---	---

Total £: 37,658 7 2

The Estimate of making the Canal from the Junction of the River Sow, above Bridgeford to Burton, in the County of Stafford; and thence to Wilden Ferry, the Distance being Twenty-seven Miles to Burton, and Sixteen from thence to Wilden Ferry. Fall to Wilden Ferry Two Hundred and Nine Feet Four Inches.

THE canal is proposed to be nine yards broad at the surface of the water, six yards at the bottom, and five feet deep: these dimensions in forty-three miles will produce 945621,6 cubic yards to be removed, which, at three-pence per cubic yard, amounts to

£. s. d.
11,820 5 4

The canal, towing-paths, and drains, being eighteen yards wide, and forty-three miles long, there will be two hundred and eighty-one acres and two roods, which, at thirty pounds per acre, amounts to

8,445 0 0

From the above junction to Wilden, is two hundred and nine feet four inches fall, which, at every ten feet fall, a lock being required, will be twenty-one locks, at 450l. each, and will amount to

— 9,450 0 0

Two funnels between each lock are required, which makes fifty-two, at ten pounds each, and amounts to

520 0 0

Thirty-six road bridges, at eighty pounds each,

2,880 0 0

Seven water bridges, at fifty pounds each,

— 350 0 0

Towing-paths, back drains, and fencing, at ten pounds per mile, forty-three miles, amounts to

— 430 0 0

£. 33,895 5 4
Five

X

	£.	s.	d.
Brought over	33,895	5	4
Five per cent. upon the whole for unforeseen accidents	1,677	5	0
	£. 35,572	10	4

Additional charges in banking for three miles, and making arches against the floods in Dove meadows, not included, 3000l.

In case the canal should be carried no further than Burton, and enter the river Trent there, would only cost 23,801l. 4s. 1d.

By carrying the canal only to Burton, to enter the river Trent there, the money saved to the public would be 11,771l. 5s. 9d.

So far my author, whose plan was rejected. I shall now proceed to describe the plan laid down by Mr. Brindley, which plan was approved and immediately carried into execution with the greatest dispatch and success. This plan is traced in the map with dotted lines.

Two tunnels between each lock are required, which makes fifty-two, at ten pounds each, and amounts to	520	0	0
Thirty-five road bridges at eighty pounds each,	2,800	0	0
Seven water bridges at fifty pounds each,	350	0	0
Towing-paths, back drains, and fencing, at ten pounds per mile, forty-three miles, amounts to	430	0	0
	£. 33,895	5	4
Five			

C H A P. IX.

Plan of the Canal proposed by Mr. Brindley.—Advantages to be expected from it.—Manufactures, Commerce, and Produce of the interior Parts of the Country, through which it is to pass.—Its Length, Breadth, and Depth.—Different Falls of the Two Canals.—Estimate of the Expence of completing it.—Comparative View of the Expence of Land Carriage and Carriage by Inland Navigation.—Comparative Statement of the Quantity of Land lost by cutting the Canal, and that necessary to grow Horse Corn only.—Facts and Reasons proving Mr. Brindley's Plan to be preferable to that of which an Account is given in the preceding Chapter.—Objections made against it.

I SHALL now proceed to describe the route of the other canal, from the river Mersey to the rivers Trent and Severn, planned and excuted by Mr. Brindley, engineer to the duke of Bridgewater, with its dimensions, the expence of completing it, and the reasons which induced the proprietors to prefer Mr. Brindley's plan to that of which I gave an account in the preceding chapter. I shall also briefly enumerate the advantages to be expected from it to the produce and manufactures of the several countries through which it passes.

At a very numerous meeting of land-owners, gentlemen, traders, and manufacturers, held at Wolseley-bridge in Staffordshire, on the 30th of December 1765, which meeting was attended by Earl Gower, lord lieutenant of the county of Stafford, and the members in parliament for that county, and those for the city of Litchfield, and towns of

Newcastle-under-line and Clithero; as also by a great number of the principal gentlemen of that and the neighbouring counties, it was unanimously resolved to apply to parliament for leave to bring in a bill for making a navigable canal from Wilden, in the county of Derby, through Staffordshire to the river Mersey.

Lord Gower opened the meeting with a very sensible and elegant speech; in which he expressed his satisfaction in seeing so many gentlemen met together upon so great a design. He declared, that he looked upon it as of the utmost consequence to the manufacturers of that and the adjacent counties, and to the kingdom in general; that ever since he had heard of the scheme, it had been his determination to support it with all his interest, both provincial and political; for he was satisfied, that the landed and trading interest were so far from being incompatible, that they were the mutual support of each other; and therefore his lordship hoped that every gentleman present would concur with him in endeavouring to carry so noble and so useful a design into execution. Mr. Brindley, engineer to the duke of Bridgewater, was then called in, and examined, and the heads of the plan were also produced and agreed to with very little alteration, and the necessary steps taken for the intended application to parliament.

It was then resolved, That it will be most convenient for the execution of this undertaking, if the expences of making and completing the navigation, which have been estimated at one hundred and one thousand pounds, were to be distributed into five hundred and five shares, and raised by subscription; and that no one person should have more than twenty shares; and the money to be advanced by each subscriber in equal proportions as the same shall be wanted; and the shares made transferable by a form to be prescribed by the act.

That a subscription be opened for a fund to defray the necessary expences in obtaining the act; and that the money there subscribed, shall,

shall, after passing the act, be repaid to such as shall not be subscribers, and allowed to such as shall be subscribers, in part of payment of their shares.

That a subscription be opened for the money which shall be wanted for making and completing the said navigation; and that fourteen days time be allowed after this day to complete the said subscription; and that subscriptions may be entered with Messrs. , at Liverpool, Manchester, Congleton, Newcastle-under-line, Stratford, Litchfield, Birmingham, Tamworth, Wolverhampton, Walsal, Dudley, Burton, Derby, Nottingham, Newark, Gainfborough, and Hull, where books will be kept for that purpose; and an account is desired to be transmitted from each gentleman of the subscriptions at each place, at the end of fourteen days, to Mr. Sparrow, in Newcastle; and if the subscription shall not then be complete, fourteen days more to be allowed.

That if the shares to be subscribed after this day shall exceed the number which shall remain unsubscribed this day, they shall be reduced in due proportion.

That it will be convenient in the execution of this undertaking, if the subscribers were to have votes, according to their number of shares, in the annual choice of a convenient number of directors, to be limited in the act, who shall have the management and inspection of the work, and to have commissioners named in the act to determine all controversies and disputes which may arise.

That proper provisions should be inserted in the act, for making full satisfaction to the land-owners and their tenants for all the lands that shall be taken for the use of such navigation, and for all damages, both present and future, which they may sustain thereby, and for the giving all proper conveniences to such land-owners, and their tenants: the
same

same to be determined by commissioners or juries, where necessary, in the usual manner.

That it be proposed for the consideration of parliament, that a proper and reasonable tonnage be fixed by the act, in proportion to the distance that each and every vessel shall pass upon the navigation; and also that the subscribers may be paid five per cent. for the respective sums advanced from the time of their paying in the same, till the whole communication shall be completed; and from that time, that they may receive their profits, according to their shares; and that the subscribers be permitted to vote by proxy.

That no toll be taken for stone, gravel, or other materials, for repairing the roads: nor for dung, soil, or marle; nor more than half tolls for lime for the improvement of lands.

Before I proceed to the particular advantages to be expected from this canal, it may not be improper to state the reasons why a canal is to be preferred to a river navigation, which are many and important. The shortness of the voyage on the former, which is protracted on the latter by the winding course of the stream; the absence of currents, which, in rivers, impede the upward navigation more than they assist the downward*, and hourly undermine and wear away the banks; the security from the mischief and delay occasioned by floods; the easier draught for the horses, as the boats will in a canal move nearer the towing-path; and the advantage of choosing high ground for the locks; while in the other case the situation of them must be regulated only by the accidental shallows of the rivers—are all circumstances

* This advantage can hardly any where appear in a more full and striking light, than at Barton-bridge, in Lancashire; where we may, at the same time, see seven or eight stout fellows labouring like slaves to drag a boat slowly up the river Irwell; and one horse drawing two or three boats on the canal, which is carried over the river at this place like a magnificent Roman aqueduct.

greatly

greatly in favour of canals ; and especially the last : for as in river navigations the locks must frequently be erected on low lands, the neighbouring meadows are thereby often rendered damp and swampy ; while in canal navigations this disadvantage is not only avoided, but, as the canal, to pursue its most convenient course, must frequently wind along the edges of the rising ground, numberless springs will be cut through, and the plain beneath rendered actually drier and more fertile. It is also another circumstance not unworthy of notice in favour of canals, when compared with river navigations, that as the conveyance upon the former is more speedy, and without interruptions or delays, to which the latter are very liable, opportunities of pilfering earthen wares, and other small goods, and stealing and adulterating wine and spirituous liquors, are thereby in a great measure prevented. The losses, disappointments, and discredit of the manufacturers, arising from this cause are so great, that they frequently choose to send their goods by land at three times the expence of water carriage, and sometimes even refuse to supply their orders at all, rather than run the risk of forfeiting their credit, and submitting to the deductions that are made on this account.

We may also add, with respect to the potteries in Staffordshire, that this evil discourages merchants abroad from dealing in those manufactures, and creates innumerable misunderstandings between them and the manufacturers.

This canal is designed to fall into the Trent at Wilden, rather than at Burton, to avoid the shallows which greatly interrupt the navigation on that river. At Harecastle, the highest part in the course of the canal, from whence the water falls north and south, it will pass above a mile under ground ; by which means fewer locks will be necessary, and more water supplied from the coal-mines in that country ; and the whole length of it, with the branches, will be upwards of an hundred miles.

The canal, and vessels to navigate thereon, are to be constructed on the plan found most eligible, from various experiments made on the duke of Bridgewater's navigation. From these experiments, his excellent engineer, Mr. Brindley, hath proposed to complete this canal as far north as Harecastle, purchase the land, erect locks, make towing-paths, build bridges, and defray every expence, except that of obtaining the act of parliament, for seven hundred pounds a mile. To cut through Harecastle, it is supposed, will cost ten thousand pounds; and the remainder of the canal one thousand pounds per mile. He proposes to make the new canal twelve feet wide at the bottom, and three feet deep in general, but at the fords only thirty inches, and in common to supply it with a quantity of water just sufficient for the navigation, and having no stream like those in Holland.

The boats are to be seventy-feet long, six feet wide, to draw near thirty inches water when loaden, and to carry twenty tons burden. They are to be so constructed as to be able to sail with either end foremost, by removing the rudder, and to cost about thirty pounds each.

There is to be a man and a boy to each boat, which one horse will draw with ease along the canal; but when necessary will be able to draw three of them.

It is proposed to raise the money by subscription in lots or shares of two hundred pounds each. No person to subscribe more than twenty shares. The tonnage to be fixed by act of parliament, and vested in the subscribers as a security for their money. The company to be under the inspection of commissioners, as in most other navigation acts. The shares to be made transferable in an easy manner, like government securities. The navigation to be free and open to all persons on paying the tonnage fixed by law; and land owners to have liberty to erect warehouses and wharfs on the banks or sides of the navigation.

It is also proposed to repay the money for obtaining the act of parliament out of the capital stock, if the application to parliament be attended with success.

PARTICULAR ADVANTAGES OF THE INTENDED CANAL.

The advantages arising from cheapness of carriage, and easy communication between the distant parts of a country and the manufacturing towns and sea-ports reciprocally, are so very extensive and complicated, that it is impossible to reduce them to any very exact estimation. If we would attempt to estimate them at all, it will be necessary to discover, as near as we can, how much the price of carriage is likely to be diminished, and what quantities or kinds of goods will probably be conveyed by this navigation.

The course of the canal is from the Mersey, at Runcorn Gap, into the duke of Bridgewater's canal, by Haulton; thence up to Preston Brook, to near Northwich; and thence to Middlewich, Warrington, Elton, Sandbach, Lawton in Cheshire, Harecastle, Burslem, Newcastle, Shelton, Stoke, Fenton, Trentham, Barleston, Darleston, Stone, Ashton, Sandon, Shutborough, Haywood, Bishton, Wolfely, Rudesly, Wichnor, Drakelow, Burton, in the county of Stafford, Egginton, Weston, Aston; and thence into the Trent at Wilden in Derbyshire.

The price of land carriage, in the neighbourhood of the canal, is upon an average about nine shillings per ton for ten miles. It is supposed that the tonnage upon the canal, for the same distance, will be about two shillings, and the freight not above six-pence more, making together two shillings and six-pence per ton; so that near three-fourths of the present carriage will be saved to the public. And the difference between land and water carriage in other places confirms the justness of this conclusion. Land carriage, for instance, between Manchester and

Y

Liverpool,

Liverpool, which are about thirty-eight miles distant from each other, costs forty shillings per ton; water carriage by the duke of Bridgewater's canal only six shillings and eight-pence one way, and ten shillings the other: suppose nine shillings upon an average; and the saving by the navigation is about three-fourths of the expence of land carriage.

If we suppose the saving to be only six shillings in nine, which is a very moderate computation, this circumstance alone will not only enable land-owners, manufacturers, and merchants to convey many articles to markets where they never could have borne the expence of land carriage; but will also bring into use many natural productions, such as coals, stone of various kinds, timber, iron ore, alabaster, &c. &c. which from their unfavourable situations never could have been employed.

To give some idea of these advantages, we must endeavour to enumerate the chief sources of employment for the intended navigation; and these may be considered under the three following heads: 1st. Natural productions of the countries that lie near the canal. 2d. Cultivated commodities and manufactures. 3d. Imported raw materials and general commerce.

From Northwich to Lawton, there lies a vast bed of rock salt, about forty yards thick, which, besides being purified and crystallized for home consumption and exportation, as will be mentioned in its proper place, might be made great use of in agriculture, and probably in metallurgy, and several of the mechanic arts, if any method could be discovered of granting the liberty of using it with safety to the revenue.

There is a mountain called Molecop, near Lawton, that contains four different and useful kinds of stone. 1st. Mill-stones, of an excellent quality, which are now carried by land upwards of one hundred miles,
and

and to all parts of the intended navigation. 2d. A good lime-stone. 3d. A fine free-stone. 4th. Grinding-stones of different sorts.

Near Wolfeley-bridge, and also a mile below Burton, a free-stone is found on the banks of the river Trent, excellent for its firmness and colour: some parts of which seem not inferior to that of Portland or Rock Abbey.

A mile from Rudgeley, a blazing kind of coal, called canel, and other coals are found, belonging to the earl of Uxbridge. The lower stratum of these mines is said to be a very valuable one; and it is apprehended a navigable fough might be carried from the new canal into the heart of them, in the manner of the duke of Bridgewater's colliery in Lancashire: and that this would lay them dry, the want of which is the present obstacle to their being worked, and at the same time convey the coals into the new canal, to the great advantage of the noble proprietor, and the neighbouring country.

Near that part of the river Trent, where the canal is to terminate, arises a vast mountain of lime-stone; on which the village of Breden in Leicestershire is situated. At Tickenhall in Derbyshire, not far from the last-mentioned place, there are also quarries of lime-stones; and at Barrow in Leicestershire they burn an excellent kind of lime for building, which is conveyed to places at a great distance by land, every way; and lime is much wanted through the whole course of the canal, both for the purposes of architecture and cultivation.

A few miles lower, at Clay Hill, a firm and elegant alabaster is found, proper either for stucco or sculpture.

Not many miles from the river Trent, near the river Soar, in Leicestershire (which it is to be hoped the gentlemen in that neighbourhood, and the inhabitants of Leicester, will now be able to make navigable without opposition), are the noted quarries of Swithland slate, a beau-

tiful and durable covering for houses, and prodigious rocks of that kind of grey porphyry which is brought from Scotland to pave the streets of London and Westminster.

A great quantity of marle will be thrown out in making of this canal; and may besides, in many places, be found so near the banks as to be delivered from the spade into the boats, which will greatly contribute to the improvement of such land as stands in need of this kind of manure. Other manures will also be procured from large towns on reasonable terms for back carriage; and as it is intended to exempt manure from the charge of tonnage, these advantages, together with the lime mentioned before, will double the produce and value of many farms bordering upon the canal.

Several parts of the country, in the neighbourhood of the canal, yield great quantities of that sort of iron-ore, commonly called iron-stone, proper for making cold short iron; and which, when mixed with the red ore from Cumberland, makes the best kind of tough iron, commonly called merchant iron. The iron-stone of this country is likewise so necessary for working the ore in the north, that even the great expence of land carriage has not prevented large quantities of it from being conveyed that way by the river Weaver to be shipped for Cumberland; and the ore from the north has been brought into this country under the like inconveniences. It seems, therefore, highly probable that the intended canal will occasion the sending much greater quantities of iron-stone into the north, and the receiving more red mine back in return, and thereby greatly increase the intercourse between these two parts of the kingdom, to their mutual advantage.

Not only these natural productions that are to be found on the banks of the intended canal, but many of those from the most distant parts of the country it is to pass through, will have their value and consumption greatly increased by this easy and cheap conveyance. Of this number
are

are lead, copper, calamine, marble, rotten stone, raddle, white clay, ochres, &c. and many other articles will probably become useful to society, which at present lie unmolested in their native beds.

From natural productions we may proceed to the consideration of those that are cultivated and manufactured; and that which deserves our first attention under this head is corn: but this subject has been already sufficiently entered into in the preceding chapter. I shall here therefore only observe that, in times of plenty, the land-owners and farmers near the canal will receive great benefit from the exportation of their grain of all kinds. In times of scarcity, the whole country will be relieved by a seasonable importation; and thus the blessings of Providence be more equally and uniformly distributed, and an artificial dearth rendered almost impossible. How ineffectual would be the attempt of the most powerful monopolizer in such a country as China or Holland, where plenty can be thrown into any market from all parts by means of navigable canals!

Another cultivated article of great importance is that of timber of all kinds, and especially oak, of which there are many large woods near the course of the intended canal, that for want of a proper conveyance to sea-port towns, where timber is much wanted for ship-building, are sold in the neighbourhood at a low price. Any method of conveying so bulky an article as this to the places of consumption at an easy expence, will greatly encourage the growth of it, and help to repair that decrease of ship timber in this nation, which is a very alarming circumstance to a people whose riches and power depend so much upon navigation.

Cord-wood to make charcoal for the iron works, oak-bark for tanners, and woad, madder, and other articles, which may become the object of cultivation, will be carried at a cheap rate upon the canal, to the mutual advantage of the proprietors and consumers. Wool, hydes, tallow, and provisions of various kinds, will become more beneficial to the owners,

owners, by the advantage of an easy conveyance to places where they may be consumed or manufactured.

As this canal will go through the middle of Cheshire, so famous for the great quantities of good cheese it produces, the advantage arising to it from the dairies will be very considerable, as many hundred tons of this article are annually carried by land above forty miles to Willington in Derbyshire, to be shipped for London and other distant markets, which will for the future be sent by water all the way to Hull and Liverpool, at a very moderate expence.

From the Wiches in Cheshire manufactured salt is carried on horseback to almost all parts of Staffordshire, Derbyshire, Yorkshire, Leicestershire, Nottinghamshire, and Lincolnshire, to which places it will gain much cheaper access by means of the intended navigation. And so great is the home consumption of this article, that from the salt works of Northwich only a duty of sixty-seven thousand pounds has been paid yearly into the exchequer: at Northwich and Winsford are annually made about twenty-four thousand tons.

The town of Burslem, and villages of Stoke, Hanley Green, Lane-delf, and Lane-end, are employed in the manufacturing of various kinds of stone and earthen wares, which are carried at a great expence to all parts of the kingdom, and exported to America, and to the West India islands, and to almost every part of Europe: but the ware which is sent to Hull is now carried by land upwards of thirty miles to Willington; and that sent to Liverpool, twenty miles to Winsford. The burthen of so expensive a land carriage to Winsford and Willington, and the uncertainty of the navigation from those places to Frodsham in Cheshire, and to Wilden in Derbyshire, occasioned by the floods in winter, and the numerous shallows in summer, are more than these low prized manufactures can bear, and without some such relief as this canal which is under consideration, our principal potteries must come
to

to speedy decay and ruin, as we have great competitors, both in France and the new United States of America, where they are pushing that business forward to great advantage.

All the branches of the metallic trades, which are almost innumerable, and carried to an astonishing extent at Birmingham, Walsal, Wolverhampton, Dudley, and other places in the neighbourhood of the intended navigation, must receive advantages from it that cannot at present be estimated or conceived.

We have already mentioned the important circumstance of bringing ores out of the north to mix with those in Staffordshire, by which the iron of that country may be rendered better and cheaper; and to this we may add the great advantage of having charcoal, lime, and other fluxes brought to the furnaces at a small expence; and likewise the great saving there may be in conveying this heavy article from the forge to the manufacturer by water. These are circumstances which must contribute to increase the consumption of English iron, and enable the iron masters in that neighbourhood to enter into a competition with foreigners, so far as to reduce the price of foreign iron, and upon the whole greatly to benefit both themselves and the manufacturers; and certainly the first object in the encouragement of any manufactory is to furnish it with its raw materials at the lowest price, to which nothing in general contributes so much as inland navigation.

By the means of this canal the iron masters will be enabled to serve the manufacturers better with their materials; and by the same means the manufacturers will be enabled to send their finished goods away much cheaper, and to more markets, by which the consumption and exportation of them cannot fail to be greatly increased.

The circumstance of a water conveyance all the way from Birmingham to the ports of Hull and Liverpool, will be a very great reciprocal advantage

advantage to all the three places. The reduction of the price of carriage, which will take place between Birmingham and the last-mentioned port, is so great a proportion of the value of guns, nails, and other heavy manufactures of iron, that the exportation of them from thence must be increased to a degree beyond estimation.

The fine ale made at Burton upon Trent, which is now exported to Germany, Denmark, Sweden, Russia, and the West Indies, may, by means of the intended canal, be exported from Liverpool as well as from Hull, to those places where it has become a very considerable article of commerce.

The valuable manufactures of Nottingham, Leicester, and Derby, will find a cheap conveyance to Liverpool by this navigation; and the demand for them at that port will consequently be increased.

In the neighbourhood of Burslem, at the potteries, bricks and tiles are made of a blue colour, which are so far vitrified as to be harder and more durable than any kind of stone used in building; and these articles will find a demand through the whole course of the canal.

Having mentioned the principal natural productions, cultivated commodities and manufactures in the neighbourhood of the intended navigation, we come to the articles of importation and general commerce.

Great quantities of flint stones used at the potteries in Staffordshire, are brought by sea from the different parts of the coast to Liverpool and Hull; and the clay used in the white and coloured ware is brought from Devonshire chiefly to Liverpool; and from thence sent up the river Weaver to Winsford in Cheshire. The flints from Hull are sent up the river Trent to Willington in Derbyshire, and from Winsford and Willington they are brought to the works at a very great expence by land carriage, the one being twenty, and the other not less than thirty-

eight miles distant from the potteries. And they are likewise subject to the same delays from floods and shallows as the manufactured goods mentioned before, to the very great disadvantage of the manufacturers; inconveniences which nothing but a navigable canal can remedy.

The iron ore from Cumberland, as it will be a considerable article of importation, must be mentioned in this place, though in another point of view it has been noticed before.

Deals and fir timber for building, and mahogany for cabinet work, which are much wanted, and are now very dear in many parts of those counties through which the canal is to pass, owing to the heavy charge of land carriage upon such bulky commodities, will be conveyed through the whole extent of this navigation at a moderate expence, and become very considerable articles of commerce.

The numerous manufacturers in Birmingham, and its neighbourhood, will in general receive their raw materials of all kinds much cheaper by this canal; such as copper, calamine, lead, zinc, ivory, and many others.

The merchants of Liverpool and Hull will supply the towns and villages bordering on the canal, with rum, wine, tobacco, sugar, and all kinds of groceries and dying stuffs, at lower prices than they have been used to receive those commodities, and with much more safety, cheapness, and expedition. And as these articles are of general consumption, the amount of them must be very considerable, and the benefit to the public proportionably great.

The salt trade will receive a very important advantage from the canal, when the navigation of the river Weaver may at any time be interrupted, as that article may occasionally be forwarded to Liverpool by this conveyance, for the dispatch of those vessels which would other-

wife be detained there at a great expence. And any injury the proprietors of the Weaver navigation have to apprehend from it, supposing the navigation should not terminate in that river, must weigh light in the balance of public utility, as their freight chiefly depends upon salt and salt-rock from Winsford and Northwich, which at present amounts to about fifty thousand tons annually, and will no doubt be still increased. And none of this is likely to come upon the new canal, but when floods or the repairing of the locks obstruct the navigation on the river Weaver, because the canal will be some miles distant from Winsford; and though it should come near the works at Northwich, the disadvantage of loading and unloading, as the canal vessels cannot live in the tide-way, will prevent the salt from being sent by them, except on such occasions as before-mentioned.

Having considered the principal advantages which the public may reasonably expect from the execution of this design, we ought not to forget the pleasures that may arise from it to individuals, especially as taste is so universally cultivated, that our farms are gradually improving into gardens. And here it must be allowed, that to have a lawn terminated by water, with objects passing and repassing upon it, is a finishing of all others the most desirable. And if we add the amusements of a pleasure-boat that may enable us incessantly to change the prospect, imagination can scarcely conceive the charming variety of such a landscape. Verdant lawns, waving fields of grain, pleasant groves, sequestered woods, winding streams, regular canals to different towns, orchards whose trees are bending beneath their fruit, large towns and pleasant villages, will all together present to the eye a grateful intermixture of objects, and feast the fancy with ideas equal to the most romantic illusions. Not to mention the convenience of having a variety of fish brought alive to our doors in well-boats, and sea and shell fish fresh and good for our tables; we shall have articles of luxury, which the inhabitants near this navigation never could have the pleasure of tasting, and which they may wish for at present in vain. So many and so important

portant are the advantages which will undoubtedly arise to the public from the intended canal, that we presume an attentive consideration of them must convince every one, that they infinitely outweigh any inconveniences which can be supposed to attend them. And it is to be hoped every friend to his country will be cautious of giving weight to trivial inconveniences, even if they should occur, in opposition to a work of this immense importance, especially at a time when our manufacturers are suffering for want of the usual demands for their goods; and when several rival nations, especially the new States of America, are exerting every nerve to avail themselves of this opportunity to seduce our workmen in every branch of manufacture to leave this country, and contribute to the support of those alarming competitors.

Some of the few objections that may be urged against this navigation have already been refuted, and those that remain do not seem to be well founded, or of much importance. It may be said, that many estates will be divided by the canal: but as in several parts it will be carried through uncultivated commons, heaths, and waste lands, that want draining (which this canal will effect), and others that are not worth tillage, and a full compensation will be made for the ground that will be cut through; and as the farms will be again connected by bridges and fords at suitable distances; it is presumed no inconveniences will arise from this circumstance, but what will be amply counterbalanced by the many advantages that have been before pointed out, and must evidently accrue to every farm through which it passes.

How far all the before-mentioned advantageous circumstances must contribute to enhance the value of our lands, to promote the wealth, strength, and splendour of the nation, and to confirm and perpetuate the peculiar blessings and privileges of its inhabitants, is referred to the candid reflection of every intelligent reader. The prospect is delightful; and no doubt many advantages to be expected from the canal now

under consideration, which have escaped my notice, will occur to the reader who lives on the spot. Those that are pointed out are, however, very numerous and extensive.

Nor will we here omit the trite objection respecting the dishonesty of watermen, that they will pilfer fruit and poultry on their passage. Certainly this class of travellers may be ranked in point of honesty with the common carriers; and as one man and a boy will be sufficient to attend the conveyance of twenty tons of goods along the canal, which by land would require the attendance of ten persons, the number of these pilfering people will be greatly diminished.

As I am desirous to anticipate every possible objection, in order to refute it as far as my abilities enable me, the only remaining one that occurs to me (and which indeed I mentioned before with a promise to obviate it) is, that by the inland navigation the coasting trade, that great nursery of seamen, will be diminished. To this it may be fairly answered, that as this inland navigation will give an opportunity for a more easy conveyance of the produce and manufactures of the interior parts of the country to the neighbouring sea-ports, which may from thence be conveyed by sea to the distant parts of the kingdom, as also exported abroad to foreign markets, whence in return other produce and commodities may be brought back, the coasting trade must thereby be greatly promoted; and as this canal will contribute to increase the produce of our farms, it cannot but benefit our present manufacturers, and occasion the establishment of new ones: it must also of course enlarge our exports, and, instead of lessening, have, in my opinion, a direct tendency to augment the quantity of our shipping, and the number consequently of our seamen. But were it otherwise, are not the public advantages which must necessarily result from this scheme sufficient to counterbalance the loss of a few hands taken from the coasting trade, even if such a loss could be proved? That, however, seems to me impossible; and shall the lessening to the number of seventy or eighty,
or

or even a hundred seamen in the coasting trade, fill us with such terrors and apprehensions as to crush a scheme that may preserve thousands from perishing? Besides, as one man and a boy at least, and in most instances two men and a boy, and very often four or five men, will be employed in each barge, these will acquire some knowledge of the nautical profession; and, having been initiated in the use of oars and sails, will, if wanted for the service of their country, soon make good seamen.

It must also be observed, that when the other parts of this great design are executed, and the principal ports and manufacturing towns of the kingdom come to have a reciprocal inland communication by water, though the coasting trade may be diminished, the export trade will not only be greatly enlarged, but the internal national commerce will be carried on with much more ease and dispatch; less exposed to expensive and hazardous delays, and perfectly secure in time of war from the depredations of an enemy.

The other part of this grand design is to have a cut for a canal, of the same dimensions as the former, from out of the grand trunk from the river Trent at Haywood, at the confluence of the river Sow with the Trent, and by Bafwick, Acton, Dunston, Penkridge, Brewood, Penford, Tunstall, Trettenhall, Wolverhampton, Treasel, Womborn, Holbeach, Prestwood, Stourton Castle near Stourbridge, Kinfare, Overly, Kidderminster, and into the river Severn, a little below Bewdley. The produce and manufactures of this part being in all respects the same as in the account particularly given of the other part of the canal, from Liverpool into the river Trent, it will not be necessary to repeat them. I shall, therefore, only just observe what a great advantage it will be to the different manufacturers, not only bordering on the canal, but also within six or eight miles of it, to have a water conveyance from their own doors, as it were, to the three greatest sea-ports in the kingdom (London excepted), Bristol, Liverpool, and Hull. Another branch has
also

also been projected (and since completed, of which I shall give a distinct account hereafter), by which this most useful inland navigation is carried into the river Thames at Oxford, which will intersect the kingdom by canals into four almost equal parts; the advantages of which cannot be estimated. But I most heartily congratulate my countrymen on their spirit and perseverance to overcome all difficulties for the public good, and the benefit of the nation.

How far these favourable circumstances must contribute to enhance the value of our lands, and to promote the wealth and flourishing state of this nation, is referred to the imagination of every intelligent reader. To have the means of conveyance so greatly facilitated, the price of carriage so much diminished, old manufactures encouraged, and new ones established, estates greatly improved, plenty widely diffused, and the country in general rendered still more affluent, populous, and secure, are considerations of such weight, as cannot fail to interest all benevolent and public-spirited persons in the success of this most important undertaking.

After giving, as I have done, the necessary detail of the particular advantages of this extensive canal, by which a communication will be opened between those capital sea-ports Bristol, Liverpool, and Hull, it may be thought, and absolutely is necessary to give the different lengths, falls of water, and the number of acres of land lost or destroyed for the use of the canal; and these I have given before relative to the former plan. I shall here, however, give them for both navigations, to save the trouble of a reference.

According

According to the first account, by the author of The Advantages of Inland Navigation, the quantity of land to be purchased is:

	Acres.
From Winsford-bridge in Cheshire, to Bridgeford-bridge in Staffordshire	214
From Bridgeford-bridge in Staffordshire, to Wilden Ferry in Derbyshire	81 $\frac{1}{2}$
From the junction at Bridgeford to Tern-bridge, Shropshire	199 $\frac{3}{4}$
Total number of acres	494 $\frac{3}{4}$

By Mr. Brindley's plan, which is executed, the number of acres is only 482. The route of the canal is from Preston Brook in Cheshire, to go into the duke of Bridgewater's, and to Runcorn, by Great Haywood, to very near Litchfield, and fall into the river Trent at Wilden Ferry. This canal comes through the great hill, called Harecastle, above a mile under ground; and from Great Haywood, by Wolverhampton, into the river Severn, a little below Bewdley; and, from Great Haywood, is called the Wolverhampton canal.

By the first plan the number of miles is 107; namely,

	Miles.
From Winsford-bridge, on the river Weaver in Cheshire, to Bridgeford-bridge, in the county of Stafford	32 $\frac{3}{4}$
From Bridgeford-bridge, in the county of Stafford, to Wilden Ferry, in the county of Derby,	43

From

	Miles.
From the junction at Bridgeford-bridge, as above, to near Tern-bridge, on the river Severn, in the county of Salop	31 $\frac{1}{2}$

Total number of miles	107
-----------------------	-----

By Mr. Brindley's plan the length is 139 $\frac{1}{2}$ miles and one furlong; namely,

From Preston Brook, in the county of Chester, to Harecastle in Staffordshire	30
--	----

From Harecastle in Staffordshire, to Wilden Ferry, in the river Trent	63
---	----

From Great Haywood in Staffordshire, to the junction of the Birmingham canal, in the same county	22 $\frac{1}{2}$
--	------------------

From the junction of the Birmingham canal into the river Severn, near Bewdley	24
---	----

Total number of miles	139 $\frac{1}{2}$
-----------------------	-------------------

By the first plan the falls of water are 730 feet 5 inches.

By Mr. Brindley's plan the falls of water are 1068 feet.

The greatest objection made by the land owners and farmers to inland navigation, is the loss of land by digging a canal, so far as private property is affected: but for this full compensation will be made, as has been mentioned before, the act of parliament, wherever a canal is made, providing for every thing of this nature. Let us only consider what an immense quantity of horse provender is consumed for the support of that

that land carriage which these canals are sure to reduce ; and what a number of acres of land will be brought into cultivation for wheat and barley, which is now wasted for horses. It appears, that every horse employed on the road is allowed three pecks of corn per day ; and seven quarters of oats on an average is the produce of an acre of land ; whence it follows, that the four hundred and eighty-two acres of land lost by the canal on Mr. Brindley's plan would keep only ninety-six horses a year, and consequently all the horses used in broad-wheel waggons, and in land carriage, on or in the environs of these canals, above ninety-six, are saved to the public ; and the land necessary to provide them with provender may be employed to grow wheat for the poor for bread, or barley to make malt for beer ; which will increase the revenue, and will keep at home vast sums of money that have been sent out of the kingdom for many years past, for the importation of oats from abroad.

It is on all hands allowed, that it is of the utmost advantage and benefit to the nation, as well as to the land-owners, farmers, and manufacturers, even to the lowest and meanest labourer and mechanic, that these inland navigations should be multiplied and carried to the utmost extent possible. That they have already succeeded beyond expectation is undoubted, and to this success may be attributed all the cuts that have since been made to the different manufacturing towns, and even to villages ; the number of which is by no means inconsiderable, as may be observed by consulting the map annexed to this work, drawn and carefully traced by the author.

I shall now proceed, after giving the description of the plans and routes of the two canals, as I first proposed, to give the observations that have been made for and against the canal falling into the river Weaver at Winsford, rather than into the duke of Bridgewater's canal at Preston Brook, and so proceeding to Runcorn ; and falling at the other end into the river Trent at Wilden Ferry, rather than at Burton ; and into

the river Severn at Bewdley, rather than at Tern-bridge, near Shrewsbury*.

Facts and Reasons, tending to shew that the proposed Canal from the Trent to the Mersey ought not to terminate at Northwich and Burton, and to prove that Plan hath been well digested, and hath not wanted public Notoriety.

That the good of a part must always give way to the good of the whole, when they happen to interfere, is one of the most essential principles of civil association; but it is at all times reasonable, that the great interests of the community should be pursued and supported with as little injury as possible to individuals.

In the course of human affairs, and during the gradual improvement in the arts of life, small things are constantly yielding to greater, bad to good, and good to better, in proportion as human genius expands, and enriches the world with its discoveries: and it is the unavoidable effect of every new improvement, in sciences or in arts, to diminish the value of less perfect systems, and works of inferior utility.

But it is a circumstance which gives much pleasure to the friends and promoters of the bill for a canal from the Trent to the Mersey, that very few individuals will suffer by the execution of this great design. And when a work of such extensive utility is under consideration, it is certainly desirable to have it executed in such a manner as to render it as complete as the nature of the thing will admit.

* Those who would wish to see all the observations and replies, remarks and counter-remarks, facts and reasons, state of facts and reasons, cases, objections, seasonable considerations, and supplement to seasonable considerations, letters, &c. &c. &c. on these canals, may consult the second part of the History (as it is called) of Inland Navigation, printed by Mr. Lowndes, Fleet-street, 1769.

The

The object of this design is not local, it is not confined to a few towns or counties. A great and general diminution of the price of land carriage, between the inland counties and sea-ports, will contribute most effectually to increase the cultivation of our lands, to reduce the price of our manufactures, and to give us a superiority over our most formidable competitors at foreign markets.

And when the branches that are already intended, and others that may be useful and practicable, are joined to this canal, the trade of a considerable part of the kingdom will receive the advantage of this new conveyance. It is therefore to be wished, that the main trunk may be terminated so as to facilitate commerce in the best manner, and such as shall most easily admit of further extension. For these purposes, the undertakers of this intended navigation are desirous that it may be terminated in a free part of the river Trent at one end, and carried to a part of the river Mersey at the other, which is not liable to the interruption of neap tides. By which means a communication may also be opened with the great manufacturing town of Manchester, and its neighbourhood; from whence the canal may be extended over the river into Lancashire, to the general benefit of the interior parts of that county, as well as the port of Liverpool, and of all the towns and places through the whole extent of the navigation.

That it would be a very great limitation of its utility, and consequently a public injury, to mutilate this great canal, by terminating it at Burton and Northwich, we presume will appear to every impartial person from the following facts and considerations:

By means of the junction of the great trunk with the duke of Bridgewater's canal near Preston Brook, merchandize will be conveyed from that part of the navigation near Middlewich to Manchester, without the interruption of a single lock, or the expence, damage, or delays

occasioned by transshipping, uniformly and certainly in twelve hours; and from that part of the canal opposite to Northwich in about ten hours. But if this canal should terminate in the river Weaver at Northwich, there must be forty-nine feet of locking between Middlewich and that place; which, at seven feet to a lock, will require seven locks, and between Northwich and the river Mersey there must be five locks more; so that all the goods going this way to Manchester, and its neighbourhood, must be carried down a sort of navigable steps seventy-five feet to descend into the Mersey; and then be mounted up another series of steps seventy-nine feet high, to come into the duke of Bridgewater's canal.

It is also necessary to observe, that all the goods must be transhipped at Northwich, which generally occasions considerable delays as well as damage, and that the vessels must wait for a sufficient tide to carry them into the river Mersey; and when they get thither, they must lie at anchor till another tide enables them to turn a point of land, and get up to Runcorn Gap. This will be the quickest passage they can make: but they may meet with contrary winds, or stormy weather, that may retard their passage many days.

It is also very material to observe the different lengths of these two roads from Northwich to Manchester. By the two rivers, and the duke's canal, the distance is forty-eight miles; by the canals, only thirty-two miles: the difference sixteen miles.

Another very material circumstance attending carriage is the price of it. As the time and risk in going from Northwich to Runcorn, by the two rivers, will always be as much, and often more than in going to Liverpool, the price will at least be equal. The comparative expence of carrying goods by the canal at Northwich, and sending them down the river Weaver, into the river Mersey, and up the duke of Bridgewater's canal

to Manchester; and of conveying them from the same place upon a level through the two canals, to that great manufacturing town, will stand as follows:

	£.	s.	d.
Tonnage and freight from Northwich to Liverpool is 5s. 3d. per ton, and we will suppose the same to Run-corn	—	—	0 5 3
Wharfage, transshipping, &c. suppose only	—	—	0 0 9
Freight and tonnage on the duke's canal to Manchester			0 4 0
Total	£.	0 10	0

By the other way it will stand thus:

	£.	s.	d.
From Northwich to the point of junction with the duke's canal at Preston Brook, being eight miles	—	—	0 1 0
From thence to Manchester	—	—	0 2 6
Freight, thirty-two miles, there being no lock	—	—	0 1 8
Total	£.	0 5	2

A difference, in favour of the article going to market, of four shillings and ten-pence in ten shillings; being very nearly half.

But suppose the expence upon this comparison should have turned out just the contrary, and the expence had been equal, certainly the risk

risk and delay of the circuitous conveyance would prevent the Manchester goods from ever being sent this way: and indeed, to all who know the circumstances, the proposal must appear too ridiculous to merit a serious confutation.

Another way has been proposed to defeat the intended union with the duke of Bridgewater's canal. It has been said, that the Manchester goods may be conveyed to and from the same points by the Cheshire canals, without this union. The agents of the bill for the great canal have constantly avoided interfering in any thing relative to the Cheshire canals. But since attempts are made to prevent the public from having a much better conveyance to Manchester, they are obliged to request that the following particulars may be properly attended to:

By means of the junction, goods may be conveyed from near Northwich to Manchester, upon a level, as has been observed before, in about ten hours, and his grace's canal is actually making, and will soon be finished. Whether the other canals will ever be made is uncertain, though they should receive the sanction of the legislature: as it is the opinion of able and experienced engineers, that they will not cost less than the enormous sum of seventy thousand pounds; and it is also very doubtful, whether all the tonnage that can reasonably be expected to come upon them will raise so much money as will be necessary to keep the numerous locks in repair; and if the subscribers should upon reflection think this may possibly be nearly the truth of the case, it is scarcely probable they will choose to risk so hazardous an experiment.

But suppose these canals actually made, the lockage up from Northwich to Motham will be not less than two hundred and thirty-five feet, and down from Motham to the level of Manchester one hundred and thirty-eight feet, which, at seven feet to a lock, will require fifty locks:
and

and the delay which this circumstance must occasion, will unavoidably be so very considerable as to render the other way much more expeditious and beneficial to the public.

It is also worthy of observation, that if the canal should terminate at Northwich, the communication between the interior parts of the kingdom and the port of Liverpool would not be near so complete as if it were to terminate at Runcorn, as the conveyance by this last place would at the same time be cheaper and more expeditious.

If goods are taken off the canal at Northwich to be sent down the Weaver, they will be liable to be retarded in the first place at Pickering's locks, about four miles above Frodsham-bridge, where there is a shallow, by which vessels are detained sometimes five, six, or seven days for want of water. The spring tides flow only here about an hour and a half each tide; and it is only during that space (except in land floods) that a boat can pass this shallow. There is likewise above Frodsham-bridge a bar that runs across the river, which, during low neap tides, is impassable for three or four days. There are likewise several other shallows in this river. These delays and inconveniences render this navigation ineffectual for the conveyance of the produce, even of the county of Chester, as far the most considerable part of the cheese produced in that county is now carried by land parallel with the whole length of this *excellent* navigation (as it is called) to Frodsham-bridge and Bank Quay; from which place it is conveyed by flats to Liverpool, there to be reshipped for London and other markets. Salt likewise, the other staple article of this county, is sent in great quantities all by land carriage from Northwich to Manchester, for the supply of that town, and a very extensive and populous neighbourhood, notwithstanding the present navigable communication between those places. These are facts that prove to a demonstration how ineffectual the present navigations are for the commerce of the country they pass through, and

and how much the counties of Lancashire and Cheshire in particular are interested in having a better conveyance. And by the immense quantities of earth brought down by the artificial river navigations (which are perpetually robbing the land-owners of considerable parts of their estates) the depth of water in the rivers is constantly diminishing; so that these interruptions will be continually growing worse.

And this navigation will not only be more liable to delays, but also more expensive, than by Runcorn; as will appear from the following comparison :

The freight and tonnage of salt and other merchandise from Northwich to Liverpool, by the present navigation, amount to 5s. 3d. per ton	—	—	£. s. d. 0 5 3
--	---	---	-------------------

The freight and tonnage from Northwich to Runcorn Gap, by the intended canal, will amount to only per ton	—	—	£. s. d. 0 2 0
---	---	---	-------------------

And from thence to Liverpool	—	—	0 1 6
			0 3 6
			£. 0 3 6

Saving per ton by the canal			£. 0 1 9
-----------------------------	--	--	----------

And why should the merchandise upon this great canal be subject to go by a dear and bad way, when it may go as well by a cheaper and a better? This would be sacrificing the public interest to a small concern, by which no person can suffer, as the salt from Winsford and Northwich will continue to go down the river Weaver to avoid transshipping ;

as that article alone will pay the interest of the debt, and as a considerable part upon that navigation may be paid off, if the trustees think proper, before the great trunk can be finished.

Let it also be well observed, for it is a circumstance of great importance, that the water at Runcorn is about five feet higher than at Pickering's lock; and that such vessels as will be used in this trade will not be liable to be interrupted there by neap tides.

These are facts, which, independent of the great object of going by a canal all the way to Liverpool, are, we presume, sufficient to convince every impartial person, that it would be much against the public interest to terminate the canal at Northwich.

It is likewise presumed, that the following important facts will also shew that the other end of it ought not to terminate at Burton.

The river Trent is navigable by nature from Gainborough to Wilden; and by an act passed the 10th and 11th of William III. the Lord Paget and his heirs were empowered to make it navigable from Wilden to Burton; for which they were to receive a duty of three-pence per ton on all the vessels that should navigate upon that part of the river.

In pursuance of this act, the river has not been pounded up one inch higher than it was before, and consequently the navigation hath not been essentially improved. Passages have only been opened through two mill-weirs, by means of two locks, which have frequently been made use of, not to facilitate but to obstruct the navigation; and by a clause in this act all persons are restrained from building wharfs or warehouses on the sides of the river, without the consent of the noble undertaker and the commissioners. This circumstance, under the ma-

nagement of the lessees, hath rendered the navigation a complete monopoly.

The distance from Burton to Wilden, by the river, is about twenty miles ; and from Burton to Wilden, by the intended canal, only fifteen miles.

If the canal should terminate at Burton, as the mills and forge below the town are in possession of the present lessees of that navigation, it would be in their power, by drawing off the water, to lay the boats aground between the warehouses and the mills ; and thereby to distress the vessels, and to interrupt all the commerce that might depend upon that part of the river.

There are upwards of twenty shallows between Burton and Wilden, which are not navigable, except when there are freshes in the river, but by means of flushes of water let off from the mills ; and by withholding this water the lessees may interrupt, and frequently have interrupted, the navigation below Burton lock ; so that the navigation of this part of the Trent depends entirely upon their pleasure.

In the weir at King's Mills there are a number of flood-gates ; one of which is very large, and was made by a former lessee on purpose to draw the water off suddenly ; and by means of these flood-gates the water may also be withheld or let off by the occupier of those mills, so as totally to interrupt the navigation.

In the year 1749, the lessees took an opportunity, when all the boats belonging to a certain company, which they wanted to distress, were below this weir, to sink a boat laden with stones in the lock ; and this answered their purpose, though it was a great injury to the public ; for all the goods that went down the navigation during the space of eight years

years and eight months, were, by the continuance of this obstacle, under a necessity of being taken out of the boats above the lock, and were then carried, or rather rolled and tumbled, into the other vessels below; by which means many goods received great injury: and much earthenware especially was sent to foreign markets broken and destroyed, under all the expences of whole and perfect merchandise.

If the canal terminates at Wilden, the manufactures, malt, and other produce of those parts of Leicestershire, Derbyshire, and Nottinghamshire, that lie near to the termination, may be conveyed by water from Wilden to the port of Liverpool, and several northern counties, and entirely escape the shallows and other inconveniences of the Burton navigation. But if the navigation were to terminate at Burton, all the goods going upwards from the above-mentioned district must either be liable to the inconveniences of that navigation, or subject to the expence of land carriage of ten or fifteen miles; which expence would convey them half way to Liverpool.

In answer to the objection, that there are several shallows in the Burton navigation, it has been replied, that there are several shallows below Wilden; by which reply it is insinuated, that if we have twenty difficulties to overcome, and cannot obviate them all, there is no advantage in avoiding one half of them:—an insinuation that might have some little weight, if boats could not frequently pass over the shallows below Wilden, by means of the additional water and freshes of the rivers Derwent and Soar, when the shallows above Wilden are impassable.

The low tonnage on the Burton navigation is also produced as an argument against extending the canal to Wilden; but although the lessees are not impowered to take more than three-pence under the name of tonnage, yet they find means to take eight times that sum on the goods carried by others, under the name of wharfage. And if it

should likewise appear, besides the expedition and uniform dispatch of a canal navigation, that goods may be conveyed to Gainsborough, from that part of the canal opposite to Burton, much cheaper than they are now carried by the river, it may certainly be presumed the advantage of extending the canal to Wilden will not admit of the least hesitation; and surely this is a plan of too much national consequence to be abridged, or injuriously limited, for the sake of those to whom the public are not so much indebted for their past services, as to lie under an obligation to indulge them in their present generous attempts to prevent any one else from serving it better.

On the best authority it is asserted, that	£.	s.	d.
the present average price of carriage, by the			
river from Burton to Gainsborough, is twelve			
shillings per ton	—	0	12 0

From Wilden to Gainsborough, a distance			
of about ninety miles, any quantity of goods			
will be conveyed at five shillings per ton		0	5 0

		0	7 0

Therefore from Burton to Wilden, or	£.	s.	d.
about nineteen miles and a half, the expence is			
seven shillings per ton	—	0	7 0

By the canal from Burton to Wilden, be-			
ing about fifteen miles, the tonnage and			
wharfage for that distance, at three half-			
pence per ton per mile, amount to	—	0	1 10 1

Freight,

INLAND NAVIGATION.

189

	£.	s.	d.	£.	s.	d.
Brought forward	0	1	10 ¹ / ₂	0	7	0

Freight, at the rate of six-pence per ton for ten miles, is	0	0	9			
	0	2	7 ¹ / ₂	0	2	7 ¹ / ₂

Saving to the public, by extending the canal to Wil- den, is four shillings and four-pence half-penny per ton	0	4	4 ¹ / ₂

It is therefore humbly submitted to the legislature, all these circumstances being considered, whether it would not be a very great injury to the public to fix the end of a canal, of such length and immense importance as that from the Trent to the Mersey, in so bad a part of a river which is a monopoly, when it may so much more advantageously terminate in a better part of that river which is free.

And as an attempt has been made to defeat this noble undertaking by insinuations, that it has not been sufficiently digested, that it wants the requisite notoriety, and by a notorious falsehood boldly asserted in print, that "A meeting at Wolfeley-bridge, held the 30th of December, was "the only one which preceded the application to parliament;" it will be requisite, for the information of those gentlemen who may not be acquainted with the subject, to state a few plain facts, whereby they may judge what credit ought to be given to publications that contain such glaring falsehoods.

A survey of the greatest part of this design was taken at the expence of the corporation of Liverpool, in the year 1755, and a plan of this survey was engraved.

Another

Another survey was made in 1758, and paid for by a subscription in Staffordshire.

In the same year a pamphlet on this subject was published in London, and dispersed in those parts of the country that were most likely to be affected by the execution of the plan ; and many towns were made acquainted with it by personal applications.

In 1760 a public meeting was advertised and held at Sandon in Staffordshire, at which Lord Gower, Mr. Anson, and the gentlemen of the neighbouring counties attended, to consider of the measures to be taken for carrying the plan into execution ; and some difficulties arising at that time, the gentlemen desired farther surveys might be made ; and that they might be extended from tide-way to tide-way ; and nearly one thousand pounds was immediately subscribed for that purpose.

The next public meeting by advertisement was held the same year at Wolseley-bridge, when another survey was made, by Mr. Smeaton and Mr. Brindley, of that part of the intended canal between Wilden and Harecastle, which was ordered to be engraved, the other surveys not being completed ; and copies of these plans were delivered to the land-owners and the neighbouring gentlemen.

By these means this design was already very generally made known, and expected to be carried into execution, as will particularly appear by the following fact :

About this time the former lease of the Burton navigation expired. The lessee applied to the noble proprietor for a renewal of it ; for which he demanded a sum not much short of four thousand pounds. The lessee offered three thousand, on condition that, if the intended canal should be made in ten years, one thousand pounds of the money should be returned. But the noble proprietor rather chose to have a small fine

certainly fixed, than to have any trouble about such contingences : and as the lessee did not comply with this proposal, his lordship did actually grant a lease of the navigation to a new company, for a certain fine of two thousand five hundred pounds, preferring this to being exposed to the trouble of future applications and deductions, on account of any interfering extension ; so that the lessees may truly be said to have received a compensation already.

After more than ten years deliberation upon this subject, it was determined to make a vigorous attempt to carry the plan into execution : and some late exactions upon the Burton navigation, added to the delays and inconveniences attending that of the river Weaver, contributed not a little towards raising a proper spirit in the country for this purpose.

A meeting was therefore called, on the 20th of March 1765, and a subscription begun towards the expence of the act ; and it was ordered, that personal application should be made to the gentlemen of Cheshire, Liverpool, Birmingham, Litchfield, and other places, to inform them of this intention, and to desire their concurrence and assistance ; which was accordingly done. The commissioners of the Weaver navigation were waited upon, at their public meeting at Northwich, on the fourth of May following, and informed that it was intended to cut past that navigation ; the reasons for which were produced to them in writing, as was likewise a plan of the canal, so far as it could then be ascertained ; and they would much sooner have had the satisfaction they now complain of not having received, if the surveyors had not been stopped by one of the commissioners, who absolutely refused to permit them to proceed with their survey.

The 13th of May, a public meeting by advertisement was held at Newcastle in Staffordshire ; when further surveys were ordered to be made, and other necessary business to be done, and the commissioners of

of the Weaver navigation sent their treasurer and clerk of the navigation to attend this meeting.

The next meeting was advertised for the 27th of June following at the same place. At this meeting the plan was agreed upon; the heads of the bill produced, read over, and approved; and near twenty thousand pounds subscribed, or promised to be advanced; and the result of this meeting was inserted in the public papers.

Another pamphlet * was then published upon this subject, of which above a thousand copies were sold and distributed; and in this pamphlet the intended junction with the duke of Bridgewater's navigation was expressly mentioned.

The last general meeting on this occasion was held on the 30th of December 1765, at Wolseley-bridge, when what had been before done and determined on was approved and confirmed; and it was again unanimously agreed to petition for a canal from the river Trent, at Wilden Ferry, to the river Mersey.

It is not therefore for want of notoriety, or because this scheme has not been sufficiently digested, that it meets with opposition; but because it has been too well digested, and offers the public more advantages than some individuals could wish, who would have been much better satisfied if the plan had been more defective.

Upon an impartial and comprehensive view of the case, respecting the intended canal from the river Trent to the river Mersey, the friends

* A View of the Advantages of Inland Navigations; printed for Becket and De Hondt, in the Strand, and Johnson and Davenport, Paternoster-row; to which pamphlet I beg leave to refer for ample proofs of the utility of the intended canal from the river Trent to the river Mersey.

of that undertaking hope it will appear, that the great outlines of this design were sketched above ten years ago ; that the plan has received many improvements ; and that the preference given to the terminations fixed by the bill, as it now stands, is supported by the clearest reasons of public utility ; that the execution of this plan will be a great, permanent, and public benefit to the agriculture and commerce of this kingdom ; that it will reduce the price of carriage six shillings in eight, and thereby enable us to meet our commercial competitors at foreign markets, upon much better terms than we can at present ; that it will greatly preserve the public roads, and lessen the expence of keeping them in repair ; that it will most essentially advance the wealth and strength of this nation, by increasing the quantity of our home products and of our exports, and by finding employment for greater numbers of vessels and seamen ; that it will diffuse a spirit of navigation through the very heart of the kingdom, and, by bringing many boys and youths from the inland counties towards the sea-port towns, greatly increase the number of our sailors ; that it will find immediate and constant employment for vast numbers of people ; and, lastly, that it will have a tendency to prevent injurious monopolies of the necessaries of life, by opening so extensive and cheap a communication between the interior parts of the kingdom and our manufacturing towns and sea-ports ; for the attempts of the most powerful monopolizer must certainly be ineffectual in a country where plenty can be thrown into any market, from all parts, by means of navigable canals.

I now propose to give the answer to what is here advanced, as I promised, and dismiss this account of the Trent and Mersey canal, to give the particulars of other navigations out of this great trunk.

Objections to Part of the proposed Canal from Wilden Ferry to the Mersey, humbly submitted to the true Friends to the Scheme "for opening a Communication between Hull and Liverpool," who wish to confine this Canal to between Burton and Northwich, which will considerably hasten the Communication, relieve the Undertakers of Forty Thousand Pounds Expence, protect Forty Thousand Pounds Capital employed in the Burton and Northwich Navigations from Ruin, preserve Thirty Miles of Land from Devastation, and completely answer all the real Purposes of public Utility.

G R E A T pains have been used in printed pieces to inculcate a belief that the plan of the canal has not wanted public notoriety; that a survey was taken in 1755, another in 1758, and a pamphlet published; a public meeting held in 1760 at Sandon in Staffordshire, and other meetings in March, May, and June 1765; at the last of which the heads of a bill were produced.

Will the projectors dare to assert, that at any of these meetings, or even at the meeting at Wolfeley-bridge, in December (really and truly the only one which ushered in this application to parliament), any idea was started of the company of proprietors participating with the duke of Bridgewater at Preston Brook, or of the canals being declared to terminate at Runcorn Gap?

N. B. Many miles of land lying out of the course of the canal will be cut through without due notice, or any regular petition: a precedent deserving the most jealous attention of parliament.

Of the project disclosed in this bill the notoriety entirely fails.

Nothing has been advanced to prove that the plan has been well digested,

digested, except in the title page of a paltry publication, intituled "Facts and Reasons, &c." No attempt has been made to prove, that any actual survey has been taken in order to apprise the freeholders interested, or any calculation made of goods likely to be carried so as equitably to regulate the tonnage. Nay, if their accurate engineer is to be believed, their capital of one hundred and fifty thousand pounds is unequal to the expence, and their scheme must be ruined; for though at one time he mentions one hundred and one thousand pounds, and at another one hundred and thirty-three thousand and eleven hundred pounds; yet the aggregate of his estimate given to the committee is one hundred fifty-eight thousand one hundred twenty-five pounds, which happens to be eight thousand one hundred twenty-five pounds more than the capital authorised to be raised by the bill.

Public utility does not require that the proposed canal should be extended beyond either Burton or Northwich, a communication between Liverpool and Hull (not Manchester) being the object of this bill.

It is therefore humbly submitted to the legislature, whether it would not be a very great injury to the public, as well as an unnecessary violation of private property, to suffer a canal to run nearly parallel for thirty miles with two good navigations, and to endanger a capital of forty thousand pounds, when it might so much more advantageously terminate at Burton and Northwich, relieve the undertakers already unmercifully loaded, preserve from depredation a fund from the Weaver navigation, which is sacred to public uses, secure thirty miles of land from grievous mutilation, and promote every consideration of real public utility.

The following candid calculations deserve attention :

By the river the present average price of carriage from	£. s. d.
Burton to Gainfborough is per ton	0 10 0

From Wilden to Gainfborough, where the navigation is allowed to be free, the average price is per ton	0 8 0
--	-------

	0 2 0
--	-------

Therefore from Burton to Wilden, about nineteen miles, the expence is per ton two shillings.

By the canal from Burton to Wilden, being sixteen miles, the tonnage may amount to	£. s. d.
	0 2 0

Freight, upon an average, cannot be less than one penny per mile	0 1 4
---	-------

0 3 4

Saving to the public, by stopping the canal at Bur- ton, per ton	0 1 4
---	-------

The Burton navigation is stigmatised as a monopoly: the present lessees have not been engaged more than three years, and are not answerable for the misconduct of their predecessor in 1749, or at any other period.

Let public indignation alight where it ought: they are anxious to meet every charge of insolence or exaction. Armed with conscious integrity, they appeal with confidence to the just tribunal of a British parliament.

By

By the canal tonnage from Witton-bridge to Runcorn, being fifteen miles, ten miles at three halfpence, and five at a penny per mile, is

Freightage at one penny per mile, for fifteen miles, is

Wharfage and transshipping at Runcorn

Freight from thence to Liverpool

£. s. d.

0 1 8

0 1 3

0 0 9

0 2 0

0 5 8

By the river the tonnage and freightage from Northwich to Liverpool do not upon an average exceed

0 4 0

So that here is a true saving by the river of one shilling and eight-pence per ton

0 1 8

The owners and trustees of the old navigations beg leave to submit,
 "That the tonnage collected by the company of proprietors ought to be
 "equal through the whole canal for every species of goods, with some
 "particular exceptions."

If the proprietors should succeed in fixing different tolls on different species of goods, a dreadful extent of mischief must follow, because by imposing a very low tonnage for all the staple articles of the old navigations, they must necessarily be stripped of all their trade; and when these are irreparably destroyed, and every possibility of contest ceases, a friendly meeting of commissioners may raise, and even perpetuate, a tonnage at the highest prices which the act of parliament authorises.

The company of proprietors ought not to be formed into a company of navigators beyond a certain number. The necessity and utility of this provision are apparent at the first view. Proprietors of tolls, by consolidating

consolidating tonnage and freightage in one charge, might take an inferior tonnage upon goods navigated by themselves, and full tonnage upon all others; and would consequently monopolize the freightage of the whole canal; for who could carry goods upon equal terms with those who can make a considerable deduction in the lock dues?

It is suspected, that the projectors do not entertain the chimerical idea of cutting through Harecastle; it is rather believed, that they are desirous of cutting their canal at both ends, and of leaving the middle for the project of a future day. Are these projectors jealous of their honour? Let them adopt a clause (which reason and justice strongly enforce) to restrain them from meddling with either end, till they have finished their great trunk. This, and this alone, will shield them from suspicion.

The old navigators are bound by every tie of duty to lay their appeal publicly before parliament; in whose wisdom and justice they repeat their dutiful confidence.

The following calculation will shew, that the intended navigation, by a canal from the Trent to the Mersey, is in danger of becoming a monopoly.

The tonnage settled is not to exceed three halfpence per ton per mile.

A high tonnage is ever the parent of monopoly, which is proved by experience in other cases.

The tonnage of three halfpence per mile, for every
ten miles, is ————— £. s. d.
0 1 3

Let it be supposed, every person carrying goods on
this canal may do it upon an average at one penny per
mile freightage, which, for ten miles, is ————— 0 0 10

Total tonnage and freightage for ten miles is ————— 0 2 1

Should the company of proprietors form themselves
into a company of navigators (supposing freightage the
same as above), one penny per ton per mile for ten miles
is ————— 0 0 10

Out of this high tonnage it is very easy to foresee
that the proprietors may abate for what goods they carry
one halfpenny per mile, which, for ten miles, will
reduce the tonnage to ————— 0 0 10

Total tonnage and freightage for ten miles, by the
proprietors ————— 0 1 8

This halfpenny abated from the tonnage is half the real value of the
freight; and therefore it will be impossible for any other navigator to
carry goods, in opposition to the company of proprietors, under an
embargo of fifty per cent. But, all competition being destroyed, they
may raise the price of carriage without limitation.

Will not this be a monopoly of the first rate?

To remedy this glaring evil, it is proposed, that the company of pro-
prietors may, by a short clause, be restrained from acting as an united com-
pany of navigators; without, however, prohibiting every individual of them
from being a navigator, or any number as partners, not more than three,
four,

four, or five, for the subdivided partnerships will rival each other, and the public by that means be secured.

If those who act for the company of proprietors of the intended canal have no design of a monopoly, they will not object to such a restraining clause. If they do, the conclusion necessarily follows.

It ought to be a fundamental rule in all public navigation bills, to keep separate and independent the offices of undertaker and navigator, as the conjunction of those offices is always found to be the principal, if not only, cause of monopoly.

During the above contest a bill was brought into parliament by the Cheshire gentlemen, in order to establish the Macclesfield canal: it passed the House of Commons, but was dismissed by the Lords. Another bill, for leave to cut a navigation from Wilden Ferry to the duke of Bridgewater's canal at Preston Brook, and from thence, jointly, to be carried on to the river Mersey, at or near Runcorn Gap, passed both houses of parliament; as did a third bill for cutting a navigable canal from the river Severn, between Bewdley and Totton Brook, in Worcestershire, to cross the river Trent, at or near Haywood Mill in Staffordshire (called the Wolverhampton canal, and which I have particularly treated upon in the former part of this work, page 175) and to communicate with a canal intended to be made between the said river Trent, and the river Mersey.

C H A P. X.

Coventry and Oxford Canals, from the Grand Trunk of the Trent and Mersey Canal at Fradley Heath, into the River Thames at Oxford.—Extent and Course of the Canal through the Counties of Stafford, Warwick, and Oxford—Its Width, Depth, Rise, and Falls of Water.—Extracts from the different Acts passed for making this Canal—Its general Utility to Trade, Manufactures, and Commerce.—Birmingham and Fazely Canal, which joins the former Canal.—Extract of the Acts of Parliament for consolidating the Proprietors into one Company.—Aqueduct at Fazeley.—Collateral Cuts from Birmingham to Digbeth and the Coal Mines.—Canal cut from near Newcastle under Line to Frogball, and Caldenloe Coal Mines and Lime-stone Quarries.—Stroudwater Canal to the Severn.—Droitwich Canal.—Account of the Thames and Severn Navigation, and the Junction of those Rivers by Means of a Canal from Leachlade to Stroud.—Short Extract from the Acts obtained for making this Junction.—A Canal to join the Thames and Severn projected in the Reign of Charles II.—Extensive Trade carried on by this and the Coventry and Oxford Canals.

COVENTRY CANAL TO OXFORD.

A MEETING was held at Banbury on the 3d of October 1768, and also again on the 25th of the same month, to take into consideration proposals for making a canal from the city of Coventry into the river Thames at the city of Oxford; which meeting was attended by a great number of noblemen, gentlemen, land-owners, merchants, and

capital manufacturers, not only of the county of Oxford, but also of the neighbouring counties; among whom were the dukes of Marlborough and Buccleugh, the lords Spencer, Guildford, and North, the Vice Chancellor, and several of the heads of houses, the two members for the university, with many other gentlemen of great weight and consequence, as well as the corporations of Oxford, Woodstock, Banbury, and Coventry; and upon the great and important question of a navigable canal projected by Mr. Brindley to be cut from Coventry to Oxford, the company present were perfectly unanimous with respect to the utility of the design, and shewed an uncommon alacrity in raising the money to carry it into execution; at the same time expressing their most sanguine wishes for the success of the undertaking.

It was proposed to make this navigable canal to communicate with the canal now making from the city of Coventry to the great Staffordshire navigation, which joins the main trunk at Litchfield. The canal is intended to pass through the several parishes, hamlets, or places of Stoke, Binley, Comb, Brinklow, Long Lawford, Newbold, Brownsover, Clifton, Hilmorton, Barby, Willoughby, Braurston, Wolfthamcote, Lower Shuckburgh, Napton, Priors Marston, Priors Hardwick, Wormleighton, Fenny Compton, Burton, Daffett, Warmington, Shotwell, Mollington, Horley, Nethorpe, and Banbury; and from thence through Adderbury, Deddington, North Aston, Middle Aston, Steeple Aston, Rousham, Shipton, Woodstock, Bladen, Begbrook, Yarnton, and Midvercot, to the city of Oxford, to communicate with the navigation of the river Thames, which places had been surveyed by Mr. Brindley, and the undertaking found to be practicable.

The sense of the county being known by the above meeting, Mr. Brindley's report and proposals were taken into consideration, and it was determined to apply immediately to parliament for permission to carry this great design into execution, a design of the most general and extensive utility to the public at large, and highly conducive to the particular benefit of the counties of Warwick, Northampton, and Oxford.

It was also resolved, that should the application to parliament be crowned with success (of which no doubt could be entertained), the undertaking should be vested in a company subscribing according to certain rules, and receiving profits agreeable to other navigation acts lately published.

Upwards of fifty thousand pounds was instantly subscribed by the company then present, for the immediate support and promotion of the project; and Mr. Dadley, of Coventry, and Mr. Walker, town clerk of Oxford, were ordered to prepare and solicit the bill, and subscriptions for the residue of the sum to be raised were soon after completed.

By the Coventry act fifty thousand pounds is the original sum to be raised. This sum is divided into five hundred shares of one hundred pounds each. The shares are made personal estate, and are transferable as such. The money subscribed in shares is made payable by different calls or instalments; and no call is to exceed ten per cent. at any one time, and between every call to that amount there must be an interval of three months. The facility of payment under this provision need not be enlarged upon. An interest of five pounds per cent. regularly paid at a stated day in every year, attends the sum advanced upon every call; and when the whole navigation is completed, every proprietor becomes entitled to a share of the full profits, answerable to the number of shares he may be possessed of.

The promising state of the Cheshire and Staffordshire navigations encouraged the gentlemen of Warwickshire to set on foot another branch of inland navigation, which is now cutting, and which will extend from the grand trunk at Fradley Heath, in the county of Stafford, to the city of Coventry, to join that canal which is cutting into the river Thames at Oxford; and it is proposed to carry on the same from Coventry by the town of Warwick to Stratford upon Avon.

An act has been obtained for the completion of that part of this canal which goes to the city of Coventry, joins the canal to Oxford, and falls into the Thames there; and the canal is finished, which has enabled the proprietors specified in the act to cut through the different parishes, hamlets, and places of Fradley, near Litchfield, Street-hay, Huddlesford, Whittington, Hoppas, Bonehill, Fazeley, Tamworth, Ammington, Polesworth, Grindon, Dordon, Merivale, Atherstone, Mancetter, Hartshill, Nuneaton, Coton, Bedsworth, Exhall, Longford, Foleshill, to the city of Coventry, with branches out of the said canal to the several coal-works which lie in its route.

This canal from Fradley Heath to Coventry was begun in 1768, and but small progress was made in it for some time, when it was found absolutely necessary, on account of other cuts requisite to be made to different towns and villages, and also to some collieries in the neighbourhood of this canal, to apply again to parliament, which was done in the year 1784, to explain and amend the former acts; and also to incorporate in one the different companies, and connect the different canals.

The act obtained in consequence of this application is intitled, An Act to enable the Company of Proprietors of the Navigation from the Trent to the Mersey, and the Company of Proprietors of the Navigation from Birmingham to Fazely, to make a navigable Canal from the said Trent and Mersey Navigation on Fradley Heath in the County of Stafford, to Fazeley in the said County; and for confirming certain Articles of Agreement entered into between the said Trent and Mersey, the Oxford, and the Coventry Canal Navigation Companies.—The Preamble is as follows:

WHEREAS by an act made in the sixth year of the reign of his present majesty, intitled, An Act for making a navigable cut or canal from

from the river Trent, at or near Wilden Ferry, in the county of Derby, to the river Mersey, at or near Runcorn Gap, certain persons therein named were united into one body politic and corporate, by the name of the Company of Proprietors of the Navigation from the Trent to the Mersey; and were authorised and impowered, by the ways and means therein mentioned, to make, complete, and maintain, a navigable cut or canal, passable for boats, barges, and other vessels, from the river Trent, below an ancient ferry, called Wilden Ferry, in the county of Derby, to the river Mersey, at or near Runcorn Gap; and several commissioners were appointed by the said act for putting the several powers thereby vested in them in execution: And whereas the said company have, in pursuance of the said act, and of another act passed in the tenth year of the reign of his said present majesty, for amending the said act of the sixth year of his said majesty, and of another act passed in the fifteenth year of his present majesty, for amending and rendering more effectual the said two former acts, made and completed the whole of the said navigation from the Trent to the Mersey, and the other works authorised by the said first mentioned act: And whereas by an act made in the sixteenth year of the reign of his present majesty, intituled, An Act to enable the company of proprietors of the navigation from the Trent to the Mersey, to make a navigable canal from the said navigation on the south-side of Harecastle, in the county of Stafford to Froghall, and a rail-way from thence to or near Caldon, in the said county, and to make other rail-ways; the said company were authorised and impowered, by the ways and means therein mentioned, to make, complete, and maintain a navigable cut and canal from the said canal so made and completed on the south-side of Harecastle, in the county of Stafford, to Froghall; and from thence to complete and maintain a rail-way for the conveyance of coals, stone, and other goods to or near several lime-works and lime-stone quarries, at or near Caldon, in the said county of Stafford, which they also have made and completed: And whereas by another act made in the twenty-third year of the reign of his present majesty, for amending and rendering
more

more effectual the said acts of the sixth, tenth, fifteenth, and sixteenth years of the reign of his present majesty, it is enacted, that the said canals, undertakings, and premises so begun and completed as aforesaid, shall from thenceforth be united and consolidated, and shall be and become, and forever thereafter continue and remain, one joint concern and undertaking in the said company of proprietors, and managed and conducted as such by them the said company; and that the said several navigations, undertakings, and premises, shall stand, be, and remain collateral securities to each other for the several sums borrowed and secured upon each of them, and for the interest of the same respectively, subject nevertheless to the several and respective sums originally borrowed and secured, or due upon each of them, and the interest thereof respectively: And whereas, by an act made in the eighth year of the reign of his present majesty, intituled, An Act for making and maintaining a navigable canal from the city of Coventry, to communicate upon Fradley Heath, in the county of Stafford, with the canal now making between the Trent and Mersey, certain persons therein named were united into one body politic and corporate, by the name of the Company of Proprietors of the Coventry Canal Navigation, and were authorised and impowered, by ways and means therein-mentioned, to make, complete, and maintain a cut or canal navigable and passable for boats, barges, and other vessels, from the said city of Coventry, to communicate, upon Fradley Heath aforesaid, with the said canal between the rivers Trent and Mersey; and commissioners were appointed by the said act for putting in execution the several powers thereby vested in them: And whereas the said cut or canal, so authorised to be made by the last recited act, hath been made and completed only from Coventry aforesaid to Atherstone, in the said county of Warwick, and the residue thereof remains yet to be executed: And whereas by an act made in the ninth year of the reign of his present majesty, intituled, An Act for making and maintaining a navigable canal from the Coventry canal navigation to the city of Oxford, certain persons therein named were united into one body politic and corporate, by the name of the Company
of

of Proprietors of the Oxford Canal Navigation, and were authorised and impowered by the ways and means therein mentioned to make, complete, and maintain a cut or canal navigable and passable for boats, barges, and other vessels from the Coventry canal navigation to the city of Oxford; and commissioners were appointed by the said act for putting in execution the several powers thereby vested in them: And whereas the said canal so authorised to be made by the last-recited act hath been made and completed only from the said Coventry canal to Banbury in the county of Oxford, and the residue thereof remains yet to be executed: And whereas at a meeting held at Colehill, in the county of Warwick, upon the 20th of June 1782, by certain delegates from the said company of proprietors of the navigation from the Trent to the Mersey, from the said proprietors of the Oxford canal navigation, and from the said company of proprietors of the Coventry canal navigation, and also from certain subscribers to a new proposed navigation from the collieries in the neighbourhood of Wednesbury to Birmingham, and from thence to join the Coventry canal near Fazeley, it was agreed by such delegates on the part of their respective companies or constituents, that, in order to effect a general communication between the Oxford and Coventry canals, and the canal from the Trent to the Mersey (therein called the Grand Trunk Canal), and the collieries in the neighbourhood of Wednesbury and town of Birmingham, it would be necessary that the Coventry canal should be completed between Atherstone and Fradley Heath; that the Oxford canal should be completed from Oxford to Banbury; and that the new subscribers should execute a canal from such coal-mines to Birmingham and Fazeley: And the more easily to effect the communication between Fazeley and Fradley Heath, it was further agreed, that the said company of proprietors of the Coventry canal navigation should, by authority of parliament, or otherwise, relinquish to the company of proprietors of the Trent and Mersey navigation, and to the subscribers to such proposed canal, that part or portion of their undertaking which lies between Fazeley, in the county of Stafford, and the said Trent and Mersey navigation on
Eradley

Fradley Heath, in the same county; and that the same should be executed by them at their joint expence; the subscribers to such new canal allowing to the said company of proprietors of the Trent and Mersey navigation five hundred pounds, as a consideration for superintending and directing the execution of such branch of the canal: and it was further agreed, that the profits arising therefrom should be divided in manner following: *videlicet*, The profits arising upon the half part thereof, from Fazeley towards Fradley Heath, amongst the subscribers to the said new canal, and the profits arising from the other half part from Fradley Heath towards Fazeley, amongst the proprietors of the navigation from the Trent to the Mersey; and that when the same should be completed, it should be equally divided between, and each part considered as the several and distinct property of the said parties, and be supported accordingly: and it was therein expressed to be further understood and agreed, that the tonnage, to be taken for all coals navigated from Birmingham throughout the intended canal to Fazeley, and upon all or any part or parts of the Coventry and Oxford canals, should not exceed one penny per ton per mile; but it was therein expressed to be understood, that the subscribers to the said intended canal were not to be restrained from taking any additional tonnage for all coals passing from the collieries and discharged at Birmingham, or at any distance upon the intended canal short of Fazeley; and by an act passed in the twenty-third year of his present majesty's reign, for making, among other works, a navigable canal from Birmingham, to join the said Coventry canal at or near Fazeley, it is declared: That the works to be done by the company of proprietors thereby incorporated had been substituted in the place and stead of those intended to be done by the subscribers to the said new proposed canal as before-mentioned; and the said agreement so entered into by the said subscribers, was by the said act enacted and declared to be binding and conclusive upon the said new company, fully and effectually to all intents and purposes.

The act then proceeds to empower the company for the Trent and Mersey canal to execute the part of the canal allotted to them; extends
the

the act of the eighth of George III. to the works to be executed by this act; consolidates this undertaking with the Trent and Mersey navigations; impowers the companies of proprietors of the Trent and Mersey canal, and the Birmingham and Fazeley navigation, to collect the same tolls on their respective parts of the said canal from Fazeley to Fradley Heath, as were granted to the Coventry company. It also impowers the company of proprietors of the Trent and Mersey navigation to borrow ten thousand pounds, and to assign the tolls as a security; enacts the form of the assignments, which are to be transferable; states in what manner the expences of the act are to be repaid; recites the articles of agreement between the grand trunk and Coventry canal companies, which agreement it confirms; provides for equalizing the tonnage of coals upon the Oxford and Coventry canals; and declares the act a public act.

The course of these canals has been given before. I have now to give the lengths, &c. From the grand trunk at Fradley Heath to Coventry, with a branch to the coal-mine, is thirty-seven miles, and all the way upon a level; and from the city of Coventry to the city of Oxford into the river Thames the length is eighty-one miles seven furlongs thirteen chains, with a rise of eighty-eight feet from Hillmorton to Naptonfield, being seventeen miles; all the rest of the way is level.

BIRMINGHAM AND FAZELEY CANAL.

IN 1785 an act of parliament was obtained to enable the company of proprietors of the navigation from the Trent to the Mersey, and the company of proprietors of the navigation from Birmingham to Fazeley, to make a navigable canal from the said Trent and Mersey navigation on Fradley Heath, in the county of Stafford, to Fazeley, in the said county, and for confirming certain articles of agreement entered into between the said Trent and Mersey, the Oxford, and the Coventry canal companies. The act contains first a recital of the act of 6 Geo. III.

for making a canal from the Trent to the Mersey; and also of the act of the 16 Geo. III. for making a branch to Froghall and Caldon for the conveyance of coals, stone and other goods, and to and near several lime works and lime-stone quarries which are at or near Caldon in the county of Stafford, which branch has been made and completed. It also recites another act passed 23 Geo. III. for consolidating the said canals, and an act of 8 Geo. III. for making a canal from Coventry to join the first-mentioned canal on Fradley Heath. It also recites another act of 9 Geo. III. for making a canal from Coventry to Oxford, and an agreement of the delegates from the said companies at Colehill in the county of Warwick, on the 20th June 1782. Then follows a part of act of 23 Geo. III. for making the canal from Birmingham to Fazeley, and for ratifying the articles of agreement of delegates, dated 29 Oct. 1783, whereby the said portion of canal is divided between the said two companies.

After numerous other articles unnecessary to mention, this undertaking is declared consolidated with the others of the Trent and Mersey navigation, and the proprietors are empowered to borrow ten thousand pounds, and assign the tolls as security; and after reciting the articles of the agreement between the grand trunk and Coventry canal companies of the 29th of Oct. 1783, and confirming the said agreement, and providing for equalizing the tonnage of coals upon the Oxford and Coventry canal, the act is declared to be a public act.

On the 12th of July 1790 the aqueduct across the river Tame at Fazeley, in the county of Stafford, was finished; and the Coventry canal, with the grand trunk, and Birmingham and Fazeley navigations, completed, and thereby the long desired communications by inland navigation between the ports of London, Bristol, Liverpool, and Hull, are completely opened.

The

The length of this canal, from Birmingham to Fazeley, is sixteen miles and eighteen chains: it has a fall of two hundred and eighty-four feet. This includes the collateral cut to Digbeth. The length of the canal from the grand trunk at Stoke, near Newcastle, to Froghall and Caldon coal-pits and lime-stone quarries, is nineteen miles three furlongs eighteen chains, with a rise of seventy-five feet in the first six miles and three quarters to Stanley Moss; and a fall of sixty feet ten inches, the remainder of the way to the coal-pits and lime-quarries. Another canal has also been cut at Birmingham, from Rider's Green to Broadwater fire-engine coal mines, being two miles and a half and six chains, with a fall of forty-six feet.

STROUD CANAL INTO THE SEVERN.

An Account of the navigable Canal from the Town of Stroud in Gloucestershire to the River Severn at Fremiload.

THE plan for making the river of Stroudwater navigable was first formed, and an act of parliament obtained for carrying it into execution, in the year 1730; but though this undertaking was promoted with great spirit, whether from the want of money or some misunderstanding among those engaged in it, or on account of the supposed loss of water to the millers, it was never completed.

In the year 1755 a new survey and an estimate of the expence of making the said river navigable were ordered; but another scheme was soon afterwards proposed by four private gentlemen to undertake the work at their own expence, without locks (and consequently without any loss of water to the millers), by shifting the cargoes into boxes, and at every mill into other boats by means of cranes. This proposal was preferred and accepted; and in the year 1759 an act was obtained

for executing it. But this scheme likewise, which did not promise much benefit to the country, in the end totally miscarried, and the projectors were nearly ruined.

In the year 1774, when many canal navigations had been successfully planned and completed in different parts of the kingdom, the project was again revived of effecting the navigation of the Stroudwater to the river Severn by a new canal. New surveys were in consequence taken, plans drawn, and estimates made by Thomas Yeoman, engineer, F. R. S. and other surveyors, after the manner of the most improved inland navigations, whereby the old river is as much as possible avoided, and the interference with the mills, which has always been an obstacle, very much prevented, as the canal communicates with the river only in three places.

When an act had been obtained, which granted sufficient powers to complete the work, a subscription was opened for twenty thousand pounds, divided into two hundred shares, which was very soon filled. Articles were executed, stating the rights and powers of the proprietors; calls were made upon the subscribers agreeably to the articles; lands were purchased, and materials provided. Thus the navigation went on smoothly and expeditiously; but certain land-holders, through whose lands the line of this navigation must pass, obstinately opposed it. They were joined by a few mill-holders upon the river. These persons advertised meetings, at which they opened a subscription, and raised a fund professedly to be spent in opposition to the navigation; in consequence of which an action was laid by a mill-holder at Framiload, for cutting through a small piece of ground, which it was his interest to prevent. The court of Exchequer was moved to stop proceedings on the canal, and the question was brought to an issue at the Gloucester assizes, when it was determined, that a canal navigation as this was deemed (though falsely, as it communicates with the river in three places) could not be made under the powers of the act of 1730, notwithstanding

withstanding the words of the act were, " That the undertakers are
" impowered to make as many new cuts as they may judge proper,
" and of what length and breadth they shall think convenient."

In consequence of this determination another act was applied for, and obtained in 1775, under which the work is now finished, and will prove of very great advantage to the country.

The course of this canal begins at Bad Brook, at the edge of the town of Stroud, passes on to Cain's Cross by Ebley, and across the main road at Stone Cross, and by Stone House, near Rycott Mill, and to Lockham bridge; crosses the river near Whitminster Mill, and goes into the river Severn at Framiload, being in length something more than eight miles, and falls one hundred and two feet.

It may not be improper to give here a brief description of the cranes and engines made use of in the year 1775, by the four gentlemen who undertook to carry on the navigation without locks.

These cranes were invented by Mr. Bridge of Tewksbury, in the county of Gloucester. He considered the mill-ponds, where there are any, as so many navigations already prepared. If they were good, he did not make them worse; but if they were bad, he made them better, by widening and lengthening them, in order that they might hold more water.

A boat being supposed to swim in this canal or reservoir above the mill, the question is, how shall the lading of such a boat be got into the stream below the mill, or *vice versa*, without the intervention of a lock or locks?—The method taken by him for compassing this end was as follows:

He cut a small canal from the water below the mill, to approach towards

wards the mill or pond above the mill; but kept the upper and lower canal entirely afunder, by means of a strong bank or wall, about twelve feet thick.

On this bank he erected a crane, or rather a double crane, for it has two necks or levers; and he caused them to act either singly or jointly at pleasure. These necks or levers are made to turn to either the upper or lower canal, as they are wanted; and when they both turn the same way, they generally act as a balance or scales.

He next proceeded to construct a boat on the lower canal, exactly of the same dimensions with that in the upper; and in both these boats he placed six, seven, eight, or more frames, capable of holding about one ton weight of goods each, and of being lifted up by means of strong hooks, with all the goods upon them.

Matters being thus settled, two men (the boatmen) begin to work the cranes; and then the lever of one crane takes a frame, with all the goods on it, out of one boat, while the other lever is doing the like by the other frame out of the other boat; and after the necks of the cranes are turned about, they interchangeably deposit their contents; both boats being by this means loaded and unloaded at the same time.

Here we may observe there is no expence of locks, no damages arising from floods, or freshes, or frosts, or the concussion of the water; nor is there any the least waste of water; so that the smallest land drain, if enough to supply a canal in a gentleman's garden, is hereby rendered fully adequate to all the purposes of an inland navigation; and when any part of the machine happens to be out of order, it is as easily repaired in winter as in summer. Not to mention, that as the crane is a double one, one part may serve (only using double the time), although the other should be broken. Besides, since all the cranes on the river are of a similar construction, materials for repairing them, such

such as beams, wheels, pulleys, chains, ropes, &c. may always be kept in readiness; so that the whole may be repaired in a few hours. Moreover, as to the difficulties attending heights, falls, or precipices, it is no great difference in the present case, whether the goods are to be lowered down or raised up four feet only, or twenty-four. And as to the important article of dispatch, it can be asserted as a certain fact, which is every day confirmed by experience, that both boats will interchange their respective loadings in less than half an hour.

But to set this scheme in its true light, I have extracted from a long laboured performance in its favour, and the answer to it, the following short unanswerable evidence to prove its insufficiency.

	H.	M.	S.
The time in making a complete trip and retrip with a forty ton barge, supposed to be in towing	8	22	50
The time to pass and repass the twenty locks, at two minutes each lock, proved to be sufficient by observation, as well as calculation	1	20	0
	9	42	50

The time to make a trip and retrip by the ten ton crane boat, all circumstances being alike, will be found, towing the same as before

	8	22	50
The time to pass and repass at the twenty mills or falls, allowing half an hour at each crane up and down, will be	20	0	0
	28	22	50

Difference of time is nineteen hours almost out of twenty-eight hours.

To

To compare the expence, suppose the towing labour comes to eighteen pence a day per man for twelve hours work, the expence of two men for nine hours forty minutes fifty seconds, in making a complete trip and re-
 trip in the forty ton barge, only ———— £. s. d.
0 2 4

The ten ton boat, to make the same trip and retrip, will require, on account of the working the cranes, two men's labour for twenty-eight hours twenty-two minutes fifty seconds, which comes to seven shillings one penny per trip and retrip, and according to the same rate forty tons for the labour of freight only come to ———— 1 8 4

The difference, being an extra charge by the crane or new scheme navigation for forty tons freight in every complete voyage up and down the navigation ———— 1 6 0

From this calculation it plainly appears, that the new scheme has a disadvantage of nearly 1115 l. per cent. and the same disadvantage will proportionably arise on any other extent of navigation. Hence it is evident, that the judgment of the legislature was right in vesting as it did all the advantage of an invention, which might not seem to them to carry that same prospect of utility, as it did to the proprietors of the machine navigation on the river Stroud.

DROITWICH CANAL.

An Account of Droitwich Canal into the Severn.

THE course of this canal begins in the town of Droitwich, and county of Worcester, and near Appletree Hill, whence it proceeds to Bryer's Mill, and over Falsham-Pill Brook to Salwarp, over Martin Brook by Hill End, through Ladywood, over Atterburn Brook, by Jacob's Ladder and Hawfordrough to Hill Top, and crosses the road from Kidderminster to Worcester, by Hawford House into the river Severn, near the place where the little river Salway goes out of the Severn, being

being a navigable course of five miles and five furlongs, and a fall of fifty-six feet six inches. The particulars of the trade, manufactures, and produce I have before given at large, when treating of the course of the intended navigations since executed for joining the rivers Severn, Trent, and Mersey, and opening a communication between the ports of Liverpool, Bristol, and Hull.

A short digression, and brief description of the river Severn, I hope will be acceptable to my readers; some of whom may not have an idea of the great trade carried on upon it, which has been an inducement for canals to be cut at every part possible to carry the manufactures and produce of the interior counties by water to Bristol, where they are sure of a market for the most valuable cargoes.

This river has its source from a large bog on the top of Plinlimmon, a mountain in Montgomeryshire in North Wales; from whence, rushing down with a swift current, and being joined by many lesser torrents, it presently appears considerable; and passing by Llanydlos and Newtown becomes navigable near Welchpool, where the river Vernew joins it, with a stream very little inferior to its own; from thence proceeding gently forward to Shrewsbury, which it surrounds nearly in the form of a horse-shoe, it flows on through a rich vale, with many extensive windings, till it comes to Benthall Edge, by the way receiving into it the river Terne, which waters all the north of Shropshire. Here the Severn begins to be rapid, being pent up between two opposite hills, both very lofty and steep; and from thence to Bridgenorth and Bewdley the channel is confined by high woody banks and rocky cliffs, which afford variety of beautiful prospects. Afterwards it again glides pleasantly on through the fruitful plains of Worcestershire, visiting in its way the city itself, and a little below is considerably augmented by the influx of the river Terne. This addition, however, is much inferior to that which it receives from its junction with the river Avon at Tewksbury, which is navigable up to Pershore, Evesham, and

Stratford. These two rivers thus united pursue their course to Gloucester, and about fifty miles below that city the name of the Severn is lost in the Bristol Channel.

This river being justly esteemed the second in Britain, is of great importance, being navigated by vessels of large burthen more than one hundred and sixty miles from the sea, without the assistance of any lock. Upwards of one hundred thousand tons of coals are annually shipped from the collieries about Madeley and Broseley, for the cities and towns situate on its banks, and thence conveyed into the adjacent countries. Great quantities of grain, pig and bar iron, iron manufactures, and earthen-ware, as well as wool, hops, cyder, and provisions, are likewise continually sent to Bristol, and other places, from whence various kinds of goods are brought in return. The freight from Shrewsbury to Bristol is about ten shillings per ton, and from Bristol to Shrewsbury it is fifteen shillings per ton. The rates to the intermediate towns are in proportion.

This traffic is carried on with vessels of two sorts: the lesser sort are called barges and frigates, being from forty to sixty feet in length, having a single mast and square-sail, and carrying from twenty to forty tons burthen. The trows, or larger vessels, are from forty to eighty tons burthen. These have a main and top mast, about eighty feet high, with square-sails, and some have mizen-masts: they are generally from sixteen to twenty feet wide, and sixty in length, being when new and completely rigged worth about three hundred pounds.

In May 1756 the number of barges and trows on the river Severn, navigating from Welchpool and Poolstake downwards to Bristol, amounted to three hundred and seventy-six, and since that time by the addition of the inland canals from the Trent, the Mersey, and the Thames, into the Stroud navigation, it may be fairly calculated, that not less than double that number are now employed. These are navigated

gated by three or four, and some by six or eight men, who are generally hardy, robust, and resolute; so that this navigation may be esteemed a valuable nursery for seamen.

So favourable an idea was entertained by the citizens of London of the utility of the junction of the Thames to the Severn, that if its completion had called for a million instead of one hundred and thirty thousand pounds, the fund would have been presently subscribed. The connections of one mercantile house alone subscribed twenty-three thousand pounds, and several others ten thousand pounds each,

JUNCTION OF THE THAMES AND THE SEVERN.

Particulars of the Junction of the River Thames with the River Severn at Stroud; and also a collateral Cut from the said Canal, at or near Siddington, to or near the Town of Cirencester, in the Counties of Gloucester and Wilts: Extracted from the Act of Parliament obtained in 1783.

WHEREAS the making and maintaining a canal, with a proper collateral cut for the navigation of boats, barges, and other vessels from the river Thames or Isis, at some place at or near Leachlade in the county of Gloucester, to join and communicate with a navigable cut or canal now made between the town of Stroud and the river Severn, in the said county of Gloucester, will open an easy communication between the interior parts of the kingdom and the port of London, which will be of great advantage to many of the sea-ports of this kingdom, and to several different manufactories in the interior parts of the kingdom, and will afford a supply of coals to those parts of the country, through which the intended canal and collateral cut are proposed to be made; and will also be of great public utility: And whereas the several persons hereinafter particularly named are desirous, at their own proper costs and charges, to begin, carry on, complete, and maintain the said navi-

gable canal and collateral cut, intended to be made by virtue of this act; but the same cannot be effected without the aid and authority of parliament: wherefore for obtaining and perfecting the good ends and purposes aforesaid, &c. &c. &c.

The proprietors are incorporated with the usual powers. Not to use the springs at Sapperton but under Lord Bathurst's direction; to carry a feeder through Lord Bathurst's gardens; and lay a water-pipe from the feeder into Lord Bathurst's mansion-house. Lands may be entered to make a survey. Levels and surveys to be taken, and entered into a book of reference. Two parts to be made thereof, and authenticated by the speaker of the House of Commons, and allowed to be given in evidence. Canal and cut not to deviate more than sixty yards from the course in the plan. Land-owners, being omitted in the book of reference, not to obstruct the making the canal and cut. The line of the canal through Mr. Eliot's lands described, and through several yards and gardens. Breadth of the canal and towing-paths. Bodies politic, &c. impowered to sell and convey lands. Satisfaction to be made in gross, or by annual rent. If rents, &c. are not regularly paid, how to be recovered. Copyhold rights to be preserved. Commissioners appointed, who shall determine differences, and settle recompences. If parties refuse to submit to, or are dissatisfied with the determination of the commissioners, or refuse to accept the purchase money, or to treat, or shall not agree, a jury shall be impannelled to assess the purchase moneys or recompence. Witnesses may be examined on oath. Jury to assess damages. Verdict of the jury, &c. to be final. Sheriff, &c. making default to forfeit five pounds. Juries under the same regulations as in the courts at Westminster. Expences of juries how to be paid. Persons requesting juries to enter into bond to prosecute. Notice of injury to be given to proprietors before complaint to the commissioners. Persons giving false evidence to be deemed guilty of perjury. Manner of making satisfaction for damages done in getting materials. Verdicts for value of lands, and money for damages, to be ascertained separate upon payment
or

or tender of moneys. Proprietors to enter to make canal and collateral cut. Verdicts to be recorded, and land to be vested in the company. Purchase moneys to be laid out to the same use. Commissioners to settle the proportions of the money to be paid to the several persons interested. Clause for the recovery of purchase money for lands. The company not to enter upon land without consent of occupiers, if the owner be out of the kingdom, or under any disability to act. Persons destroying the works shall be adjudged guilty of felony. Proprietors may raise one hundred and thirty thousand pounds among themselves. Application of that sum. The money to be raised to be divided into thirteen hundred shares, at one hundred pounds each. Shares deemed personal estate. If one hundred and thirty thousand pounds should not be sufficient, the company may borrow sixty thousand pounds, and assign the navigation, &c. as a security. Form of assignment. Assignments to be entered into a book, and may be transferred. Form of transfer. Transfers to be entered by the clerk. The interest of the money borrowed to be paid first. Three per cent. to be paid to the proprietors till the work is completed. Subscribers to have a vote for every share by themselves or proxies. General assembly for choosing committees. Committee subject to controul of general assembly. Books to be kept. General assemblies to consist of five hundred shares. Power of general assemblies. Subscriber forfeiting his share to have personal notice, and the forfeiture must be declared at a general assembly. General assemblies may make bye laws. On the death of subscribers before their shares shall have been completed, executors may do it. Shares may be disposed of. After a call no share to be disposed of till the money paid. Form of the sale. Officers to be appointed. The clerk's duty. Proceedings of commissioners to be entered in a book, and to be admitted as evidence. Rates allowed to be taken, viz. for tonnage and wharfage upon coal, between the Stroud canal and Sapperton tunnel, one shilling and three-pence per ton. Between the west end of Sapperton tunnel and Cirencester, one shilling per ton. And between the Cirencester branch at Siddington and Leachlade,

two shillings per ton. And for iron, salt-ores, salt-rock, lime-stone, chalk, crates of pottery, crates of black glass, timber, flint, bricks, stone, clay, copper, brass, and tin, and tin-plates, lead, spelter, and pot-metal, window-glass, and plate-glass, two-pence per ton per mile; and three-pence per ton per mile upon all other goods and merchandises whatsoever; and so in proportion for any greater or lesser quantity than a ton, or any greater or less distance than a mile. Rates how to be recovered. Further allowance for goods remaining upon the wharfs above twenty-four hours. Masters of boats to give an account in writing to the collectors of the particulars of the goods, on penalty of ten shillings per ton. What quantity of timber shall be deemed a ton. In case of difference concerning the weight of goods, collectors may weigh them, &c. The proprietors are empowered to regulate and fix the prices of small parcels under a hundred weight. The navigation to be free upon paying the tolls. Boats of less burthen than on the Thames and Severn. Boats not to pass without leave. A clause allowing the owners of lands to use pleasure-boats on the canal. From such time as the new intended canal shall be completed from Wallbridge to the distance of one hundred and fifty yards above the high road, which crosses the line of the said new canal at Brinscombe (at which spot there will be a bridge over the said new canal), in manner sufficient for the passage-boats, and for so long as the same canal shall be so continued, the proprietors of the Stroud-water navigation shall, in lieu of the present rates, demand the following: viz. for coals carried from the commencement of the navigation at the river Severn to the termination at Wallbridge, and passing from thence into the said new canal, and going thereon any distance not exceeding one hundred and fifty yards above the aforesaid road, two shillings and three-pence per ton; but for coal going more than one hundred and fifty yards above the said road, and not afterwards returned back again below the said boundary of one hundred and fifty yards from the said road, one shilling per ton, in lieu of the said two shillings and three-pence per ton. But if at any time such coals or merchandise having paid the one shilling per ton only to the Stroud canal

canal company, shall be landed at any place between Wallbridge and the distance of one hundred and fifty yards above the said road at Brinscombe, or shall be brought back again from above the said boundary of one hundred and fifty yards from the said road, then five shillings per ton shall be paid to the Stroud canal company, by the master of the boat; out of which such coals or merchandise shall be so landed or returned.

For flints, bricks, stone, clay, chalk, salt-ores, salt-rock, and limestone passing from the said Stroudwater navigation into the new canal, and going thereon more than one hundred and fifty yards above the said road, and not returned afterwards back again below the said boundary of one hundred and fifty yards from the said road, or going out of the said new canal into the Stroudwater navigation, and having previously at any time passed along any part of the said new canal, above the said boundary of one hundred and fifty yards from the said road, one half-penny per ton per mile shall be paid. And for timber, black glass-bottles, and phials, and crates of pottery, one-penny per ton per mile. And for iron castings and wrought iron, and all other goods and merchandises whatsoever, one-penny half-penny per ton per mile; and so in proportion for any greater or less quantity than a ton, or any greater or less distance than a mile: but for any of such enumerated articles, or of such other goods or merchandise passing from the said Stroudwater navigation into the said new canal, and not going thereon further than one hundred and fifty yards above the said road, or going out of the said new canal into the said Stroudwater navigation, and not having previously at any time passed along the said new canal, above the said boundary of one hundred and fifty yards from the said road, two shillings and three-pence per ton shall be paid in lieu of such several rates before mentioned. There shall be a free communication between the intended canal and the river Severn, on payment of the rates. Rates to be taken by the Thames and Severn company in consequence of the above, viz. for coals carried upon the Stroudwater na-

vigation, from the commencement thereof at the river Severn to the termination at Wallbridge, and passing from thence into the new canal, and going thereon no further than one hundred and fifty yards above the said road, one shilling and three-pence per ton ; but for coals going more than one hundred and fifty yards above the said road, and not afterwards returned back again below the said boundary of one hundred and fifty yards from the said road, then such sum as the proprietors of the Thames and Severn navigation shall think proper. And when the Thames and Severn company lower their rates, the Stroudwater company are to lower their rates. The powers of the Stroudwater company, within their own limits, are not altered, unless they reduce their rates taken at Wallbridge. Materials for making and repairing the respective canals to pass free mutually. Persons navigating the Thames and Severn canal not to land goods on Wallbridge wharf without leave, except materials, whilst the navigation is making. Boatmen to shew their pass-tickets. Drains to be made in the canal to convey the water from the lands adjoining, and how the same are to be maintained. Land-owners aggrieved by the obstruction of the company's water-courses, may cleanse them at the company's expence. When cattle shall be deprived of watering places, others to be provided. Clause for fencing off the towing-paths, and making bridges. If the company do not fence off the towing-paths, and make bridges, &c. land-owners may do it at the company's expence. If bridges, &c. made by the company are insufficient, land-owners may make others at their own expence. The company enabled to cleanse the adjoining water-courses at the land-owners expence, if they neglect. Land-owners may erect warehouses, &c. on their own lands. Masters to put their names on the outsidcs of the boats, and suffer them to be measured, on penalty of forty shillings. Boat-master or owner made accountable for damages done by the crew. Proper places to be made for boats to turn or lie in, for other boats to pass by. Vessels lying so as to obstruct the navigation to be removed. Vessels sunk to be weighed up. Persons overloading and obstructing the passage of the canal, to forfeit five pounds. Persons throwing

throwing ballast into the canal to forfeit ten pounds. Persons opening the locks, or doing other damage to the navigation, to forfeit a sum not more than five pounds, nor less than twenty shillings, at the discretion of the justices. Regulations of vessels passing through the locks. Vessels passing locks with less than six tons to pay a lock due, and tonnage for six tons. Canal not to be under the power of commissioners of sewers. Proprietors to be taxed for lands and buildings, in the same proportion as adjoining lands and buildings. Land-owners are allowed to carry manure toll free. Rights of lords of manors and land-owners to the fishery reserved. Persons on board having nets, &c. not being qualified, forfeit five pounds. Stones to be erected every half mile. Mode of electing new commissioners. Their qualification. Commissioners acting, not being qualified, to forfeit fifty pounds. Commissioners to give notice of their meetings. Commissioners to be sworn. The oath. Commissioners may act as justices. No commissioner to act as such while he possesses any place of profit. General meeting of commissioners. Meetings upon request may be summoned at any time. No meetings to determine disputes, &c. but within five miles of the canal. Writings to be exempted from stamp-duties. Security to be taken from the treasurer, &c. Clause to compel payment of subscriptions. Penalties and forfeitures how to be recovered and applied. Persons aggrieved by any irregularity in distress to recover only the special damage. Persons aggrieved may appeal to the quarter-sessions.

I hope this long extract may not be thought superfluous, as it could not easily be comprised in a shorter compass.

History informs us, that so long ago as the reign of Charles II. a project was set on foot for uniting the Thames with the Severn, by cutting a channel of above forty miles in length; and that a bill was brought for that purpose into the House of Commons. Joseph Moxon, who was hydrographer to the king, and an excellent mathematician, drew a map for Mr. Matthews, to shew that the scheme was practicable.

In Dr. Campbell's Political Survey of Great Britain he observes, that the correspondence between London and Bristol being very expensive by land, and tedious by sea, it was natural to endeavour at finding some means of lessening at least, if not removing, these inconveniences. In order to this it was proposed to make use of the Avon, which runs to Bristol, and the Kennet, which falls into the Thames; but it does not appear this ever went further than speculation. In the reign of Charles II. a bill was brought into the House of Commons, to unite, by a new cut from Leachlade, the Thames with the Avon, that passes through Bath. Captain Yarranton proposed the same thing, by uniting the Thames by the Charwell, to the Avon by the Stour, and so to the Severn, with only eight miles of land-carriage. It seemed necessary to mention these, because it may become requisite to review and fix on some one of them at a future time, when, in consequence of a method to be hereafter explained, a communication shall be accomplished between Hull, Liverpool, and Bristol; for in that case some such communication by water will be necessary to maintain that intercourse between the midland counties and the capital, which is of so great consequence to both.—So far Dr. Campbell. It is needless to observe, that what he suggested is now completed, but not by the course he has pointed out.

The idea of forming a communication between the Thames and Severn, by a canal, did not escape the imagination of the immortal Pope, who thus writes in a letter to a friend: “ I could pass whole days in describing to her the future, and as yet visionary, beauties that are to rise in those scenes (speaking then of Lord Bathurst's woods at Cirencester), the palace that is to be built, the pavilions that are to glitter, the colonnades that are to adorn them; nay more, the meeting of the Thames and Severn, which, when the noble owner has finer dreams than ordinary, are to be led into each other's embraces, through secret caverns of not above twelve or fifteen miles, till they rise and celebrate their marriage in the midst of an immense amphitheatre,

“ theatre, which is to be the admiration of posterity a hundred years hence.
“ But till the destined time shall arrive, that is to manifest these won-
“ ders, Mrs. Digby (the lady of the honourable Robert Digby) must
“ content herself with seeing what is at present no more than the finest
“ wood in England.”

The execution of this grand work, with others equally wonderful and useful in different parts of this kingdom, was reserved for the reign of George III. I have before mentioned the canal cut from Stroud to the Severn, near Fremiload, after many unsuccessful attempts to make the river Stroudwater navigable. Mr. Robert Whitworth, that able and successful engineer in works of this kind, was employed in 1782, at the desire of several opulent private persons, chiefly merchants of London (not the corporation), who had no local interest in either of the counties of Wilts or Gloucester, through which the canal passes. The act passed in the year 1783; an extract of which I have just given, and was agreeable to the plan and estimate of their engineer, who had stated the sum requisite to complete the undertaking at one hundred and thirty thousand pounds, and was empowered to borrow a further sum of sixty thousand pounds more if wanting, to finish the said canal on mortgage, under their common seal.

This navigable canal begins at Wallbridge, near Stroud (at the very place where the Stroud navigation ends), and proceeds to very near Leachlade, on the river Thames, being a distance of thirty miles seven chains and a half, exact measurement. The general breadth of the canal is forty-two feet at top, and thirty feet at the bottom. In many places, where the ground is a dead level, it is considerably wider; the banks and towing-paths being made entirely with the soil dug from the canal. The tunnel at Sapperton is nearly two miles and a half in length, being lined with masonry, and arched over at top, with an inverted arch at the bottom, except at some few places, where the solid rock being scooped out renders it unnecessary. The boats are twelve

feet wide, and eighty feet long, and when loaded draw four feet water, and will carry seventy tons. This whole canal was executed in the most masterly and complete manner within the time proposed, which was seven years.

In order to form any proper judgment of the importance to commerce of this undertaking, it will be necessary to take a large and comprehensive view of the intercourse between the ports of Wales, Bristol, Gloucester, Worcester, and even Shrewsbury; and also of the numerous inland navigations connected with the Staffordshire and Worcestershire canal; and of the intermediate courses of the river Thames, from Lechlade, by Oxford, Wallingford, and Reading, to London. The various articles of produce and manufactures in such a scope of country, which comprehends the whole internal trade of the kingdom, are more perhaps than I can immediately enumerate, and indeed such an enumeration is almost needless, as I have before given, when speaking of the course of the canals, a particular account of the natural produce, manufactures, and commerce, not only of those counties, but even of the towns and villages through and near which they pass.

The advantages to the inhabitants living on the banks of the canals, and also on the banks of the rivers into which canals are cut, are almost inconceivable. The artist, the trader, the manufacturer, are all enticed as it were to industry, as new veins of trade are opened to their view, and by the constant, easy, cheap, and certain carriage of their goods to a market, while raw materials for working are brought back to their doors by the same conveyance. The connection of the river Thames with the Severn, by the means of this canal, and also with the internal parts of the kingdom, by the Oxford and Coventry canals, which lead to Birmingham, and also the counties of Stafford, York, Cheshire, and even to Westmorland, forms a line of communication with the capital, of the greatest importance, and which cannot but excite a prodigious spirit of enterprise among the citizens and traders.

On the 20th of April 1789, Mr. Clowes, the acting engineer, left to conduct the business under Mr. Whitworth (who was then also employed in the Firth and Clyde canal navigation in Scotland), passed through the tunnel for the first time at Sapperton, in a vessel of thirty tons burthen; and the junction was completed, and a vessel passed from the Severn into the Thames for the first time on the 19th of November in the same year, in the presence of a multitude of people, who came from all parts of the country, within ten or twelve miles, on the occasion.

On the 19th of July 1778, when their majesties were at Cheltenham, they expressed a desire to view the tunnel at Sapperton, in the praise of which fame had been so lavish. Accordingly that day was appointed, and his majesty visited the entrance with astonishment and delight, and bestowed the highest praise on a work of such magnitude, expence, and general utility, and expressed still greater satisfaction when he was informed, that it had been conducted and completed by private gentlemen.

The length of the canal, I have before observed, is thirty miles seven chains and a half, of which from Stroud to Sapperton is seven miles three furlongs, with a rise of two hundred and forty-one feet three inches; from Sapperton tunnel to Upper Siddington, and the branch to Cirencester, nine miles and eight chains and a half, and is level; from Upper Siddington to Lechlade is thirteen miles four furlongs and nine chains, and with a fall of one hundred and thirty feet six inches.

A very intelligent author says, that so unfavourable was nature to the design of joining the river Thames to the Severn, that a subterraneous cut sixteen feet square must be made through two miles of solid rock at the expence of eight guineas per yard. The place he alludes to is Sapperton tunnel.

C H A P. XI.

Account of a Proposal for opening a Canal Navigation from the River Thames to the Severn.—Project to shorten the Thames Navigation, by a Cut or Canal from Monkey Island, near Maidenhead, to Reading.—The Scheme at present rendered abortive.—Account of the intended Canal from Reading to Isleworth.—Its Utility.—Section of the River from Mortlake to Boulter's Lock.—Account of the Canal projected from London to Waltham Abbey, into the River Lea.—Canal from Limehouse into the River Lea.—Leeds and Selby Canal.—Account of the Huddersfield Canal.—Leeds and Liverpool Canal.—Kendal Canal to Liverpool.—Plan for an Inland Navigation from Kendal to London, above Five Hundred Miles in Length, and other Navigations which might be carried into Execution to great Advantage.—Basingstoke Canal.—Andover Canal to Redbridge, near Southampton.—Winston Canal, in the Bishoprick of Durham, by Darlington, to Stockton, on the River Tees.—Chester Canal to Middlewich, with the Branch to Nantwich.—Birmingham Canals.—Langley Bridge Canal.—Chesterfield Canal.—Proposed Canal from Bude to Launceston in Cornwall.—Canal from Market Weighton to the Humber, and for draining Twenty Thousand Acres of Land.—Canal cut by Sir Nigel Gresley, to supply the Town of Newcastle under Line with Coals, from his Estate at Apesdale, in the County of Stafford.—Canal cut by the Earl of Thanet, from his Estate called The Spring, near Skipton Castle, in the County of York, to join the navigable Canal from Leeds to Liverpool, to supply the Neighbourhood with Lime and Limestone.—Account of the Canal cutting from Cardiff, in the County of Glamorgan, in South Wales, to a Place called Merthyr Tidwell, in the same County.—Projected Canal from Neath, in the same County, to Furno Vaughan.—Account of Two Canals already cut through private Property for the public Good; one of them from near Swanzey to Neath, through a Morass; the other from Kidwelly in Carmarthenshire, to the Coal-mines of Mr. Keymer.

INTENDED

INTENDED CANAL FROM MONKEY ISLAND TO
READING.

IN 1754 a proposal was made for opening a navigation between London and Bristol, by the way of Hungerford, Marlborough, Coln, Chippenham, and another by the way of Oxford, Lechlade, Cricklade, Malmesbury, and Chippenham. It was projected to join the Severn, Trent, and Humber, by the means of the two rivulets Penk and Stour, which would give the advantage of water-carriage to seventy-one cities and market-towns.

A canal fifty feet wide at top, thirty at bottom, and four feet deep, might be made at the rate of three hundred pounds per mile, by employing the soldiery in the work, with an additional eight-pence a day, and allowing seven hundred pounds a mile for the purchase of grounds, building locks and bridges, and making reservoirs. The amount of the whole expence would be about one thousand pounds a mile; and consequently three hundred thousand pounds would complete a navigable canal three hundred miles in length, which is more than necessary for the purposes required.

The proposer of the above confesses himself no engineer (which is very obvious); but says he was led into that train of reflection by a journey he made in the year before (in 1753) through Flanders, where he saw seven thousand Austrian soldiers at work on the canals between Ghent and Ostend, to make a watery highway (as he terms it). The expence of this, and the erection of locks at Sas-van-Ghent, could not amount to less than two hundred thousand pounds, which was to be raised by a land-tax laid on by an assembly of the estates of Brabant, at Brussels. This vast expence was voluntarily incurred only to make a commercial highway for about forty miles in length. Of such importance

portance to commerce do that prudent and wise people consider an easy communication between city and city to be. So far my author.

The advantages arising from canal navigations to manufactures, commerce, and agriculture, above those of navigable rivers, are universally acknowledged. There have been many courses for navigable canals pointed out in this kingdom, that are practicable and eligible; some of which have already been carried into execution with honour and profit to the proprietors, and credit to the engineers and conductors, as has already been shewn; but there are none from which greater benefits and advantages would arise to the public, and to the counties through which they pass, than a cut from Monkey Island, in the river Thames, near Maidenhead to Reading, in the county of Berks (though this is in fact only part of a larger design, which I shall hereafter mention); for by means of such a canal the price of provisions would be greatly lessened in London, and the country supplied with coals at a much cheaper rate. By this canal also, in order to shew the particular length of the intended navigation, the distance is only fifteen miles and a quarter, and by another route only fourteen miles and three quarters, but by the river it is above twice that distance.

The expence of taking a barge of one hundred and twenty tons burthen from Monkey Island to Reading, has been proved, before a committee of the House of Commons, to be fifty pounds, and the passage cannot be performed in less than three days, and often three weeks, and it has even been known to have been two months; whereas, by a canal, it may be performed, at all seasons of the year, excepting a very hard frost, in six hours, and at the expence of only four pounds seven shillings; supposing the tonnage to be laid at a halfpenny per ton per mile, as is proposed.

By the river, the distance can never be shortened, nor can the labour of passing against the stream ever be avoided. It is confessed likewise, that

that no method can be discovered to make the river navigations passable in time of floods, which in most years continue for several months during the winter.

As no private property will be allowed in the canal (the money being intended to be raised by annuities), it is presumed the proposers will have every inducement to make ample satisfaction for injuries to individuals, nor is it possible they can have any motive to the contrary.

No private person can receive any benefit that is not common to the public; therefore the public only are interested in this useful design, as this canal is intended to be a free navigation after the tolls have paid off the expences of making it, and a sufficient fund has been accumulated to keep it in repair, which it is apprehended, from a moderate computation, will be in less than forty years.

Notwithstanding these arguments are not to be confuted, yet some individuals, pretending their private property would be injured, the country drowned, and raising many other such weak and absurd objections, which could only be started by men of contracted and self-interested views, have found means (in a great assembly) to have this useful scheme rejected. But it cannot die; for its merits most certainly one day or other will revive it. I hope my readers will not be offended at my informing them of what may be done, as well as what has been done, with respect to the river Thames; for although some of these plans have not yet been executed, yet when the different canals in the interior parts of the country are completed, which are drawing fast to a conclusion, and the benefits and advantages derived from a communication between those great sea-ports Bristol, Liverpool, and Hull, which are now happily united by an inland navigation, shall have become generally known, it is very improbable that the city of London, the first

in the world for commerce, will tamely lie idle, and not take advantage of the opportunity to come in for her share. Indeed it is an unpardonable fault somewhere, that London did not take the lead, and set the example in a work of such great national importance, and not suffer a few interested individuals to oppose a scheme of such magnitude, but make a vigorous application to parliament, which no doubt will view the advantages of the plan in their proper light, and not suffer the public good to be obstructed by private individuals, but rather take example by the wise regulations of the empire of China, where not even the emperor's gardens or pleasure-grounds are sacred from a public canal.

INTENDED CANAL FROM READING TO ISLEWORTH.

AFTER the above particulars, it may not be improper to proceed to acquaint those who would wish to be informed of what is proposed to be done by the city of London, and county of Berks, towards making a navigable canal from Isleworth, in the county of Middlesex, to the town of Reading, in the county of Berks, and repairing the channels of the old river.

At a general meeting holden at the Town-hall at Reading, on Tuesday the 9th day of October 1770, it was agreed, that a canal should be cut from Sunning to Monkey Island, and that no person whatever should be injured thereby. It was also agreed, that the river Thames from Sunning to Boulter's Lock should be amended at the expence of the canal, without any other toll being taken upon the river than what is now taken.

At

At the same time it was agreed, that the money should be raised by life annuities, and when the tolls collected should have paid the expences of cutting the canal and repairing the river, and when a sufficient sum should be accumulated for the perpetual repair thereof, that then the navigation for ever after should remain and be a free navigation.

And at another meeting held on the 7th of November 1771, at Reading, it was further agreed, that the said canal be of such dimensions as to admit of the largest barges now navigating the river Thames to Reading, to pass and repass freely in every part.

When the design of this canal was first laid before the city of London, a committee was appointed to enquire into the utility of such a measure, and every proper step has been since taken to extend it. Plans have been made, and estimates prepared, both for making a canal from Isleworth to Monkey Island, and also for repairing the river from Monkey Island to Mortlake, in the county of Surrey; so that the application of the commissioners for repairing the river by an additional duty upon coals, seems to be precluded, because the river will be repaired without any expence to them, and without any additional toll upon the river; the consequences of which will be, that all the trade upwards will pass upon the canal, because that being still water, and the distance shortened, the expence and labour will be greatly reduced, and most of the trade downwards (except in the time of floods) will be by the river, because the barges and boats will be able to fall down the stream without labour, and save the expence of returning by the canal. In consequence of the increase of navigation, the river will have a much greater trade downwards than ever it had before, and the canal will be less obstructed by vessels returning to London; and it being intended to be of such dimensions as to receive the largest barges navigating the river Thames westward, it is supposed it will not be possible for any person whatever to be injured by it. For by Mr. Brindley's first re-

port it appears, that the expence of taking up a barge of a certain size from Isleworth to Sunning, and back again by the river, is eighty pounds, which by the canal may be done for sixteen pounds; so that there will be a saving in expence of sixty-four pounds out of eighty pounds, without noticing the difference in time, or damage of goods, loss by pilferings, and disappointments by long droughts in summer, and floods in winter, incidental to the river navigation.

From what has been said, it will appear that the most expeditious passage for all vessels going upwards to Henley and Marlow, will be to pass the canal to Sunning (which may be done in one day with the largest barges), and fall down the river to Henley and Marlow, without labour of the stream. A lock being placed below Monkey Island, for the better crossing the canal, will make level water, and an easy passage up to Maidenhead and Boulter's Lock.

A branch of the canal is proposed to fall into the river about Windsor-bridge, for all vessels going from London to Windsor, Datchet, Old Windsor, &c.; and a branch also is to be cut from West Belfont to Staines, Laleham, Chertsey, Weybridge, the Guildford navigation, Sheperton, Sunbury, &c.

And for the more easy passage from London to Brentford, Isleworth, Richmond, Twickenham, and Kingston, a good towing-bank will be brought down as far as Mortlake; and a dam will be made with cistern-locks, to keep the banks always full to high-water mark, which will preserve level water up to Tedington. By this means most vessels will be able to reach Mortlake in one tide from London, and will then be sure of an easy passage and level water into the canal: an improvement which will make the whole country above it the most delightful spot in Europe.

Any person, by inspection of the map and course of the river
Thames,

Thames, will discover at first sight the great utility of this undertaking ; for by carrying the eye in a straight line from Maidenhead to Isleworth, it will be perceived that the navigation will be shortened two parts in three.

To give the profile or section of the river from Mortlake to Boulter's Lock, near Maidenhead, with all the deeps and shallows, would be too tedious, and of little utility here. But the different falls or descents of its surface at Boulter's Lock may be worthy notice. The water above the lock appears to be above five feet deep ; but below, the vast force of the water coming down from such an unmechanical lock, has worked or dug a hole of twenty feet perpendicular depth, and above one hundred feet in length ; beyond which rises a hill thrown up by the great force of the current, where the bed of the river has little more than three feet depth of water.

The whole fall from Boulter's Lock to Mortlake is seventy-five feet seven inches, and the distance is forty-one miles one furlong. This survey and measurement was taken for and by the order of the city of London, in the most accurate manner, to shew the impossibility of making a good navigation in the bed of the river, or any other where the fall is so great, as has been proved by sad experience in many instances. It may not perhaps be amiss to mention a few among several.

The river Avon, from Salisbury to Christchurch, was made navigable, and was opened but a very short time before it was entirely destroyed by the floods, and it has not yet been thought worth while to repair it. There is some intention, as I am informed, to make a canal parallel with it. The river Stour, from Stourbridge to the Severn, has undergone the same fate. The navigation of the rivers Mersey and Irwell have had most of their works destroyed by the rapidity of the floods. And the navigation of the river Calder in Yorkshire, about the year 1774, was very greatly damaged, and rendered impassable

fable for above twelve months, and then repaired at a very great expence ; but it still remains exposed to the same danger.

INTENDED CANAL FROM LONDON TO WALTHAM ABBEY.

BEFORE I quit the subject of the metropolis, I will give some short account of an intended navigable canal from Waltham Abbey, in the county of Essex, into a large basin, to be cut in Moorfields, London—a most noble improvement, projected and promoted by Mr. James Sharp, for the advantage and ornament of the city of London.

Mr. Sharp, having conceived the idea of a grand canal of communication between London and the adjacent country, made choice of the area of Moorfields, as the extreme point to which it might be most commodiously directed. With this view, about the year 1772, he caused the level to be taken from the quarters of Moorfields, in order to try where it would run into the river Lee, when, to his great surprise, he found it extend no less than thirteen miles and a half, and to approach so near to Waltham Abbey, as to make that place the other extreme point from whence it might proceed. In the course of this survey it was observed, that such a canal would in its progress pass through a pleasant part of the country, through every capital village in the course of its direction, and through inclosures, exhibiting the richest and most delightful rural prospects that can be conceived.

The gentleman Mr. Sharp employed in taking this survey, was the ingenious Mr. Robert Whitworth, who was draughtsman to the late celebrated Mr. Brindley, and assisted in projecting most of his magnificent works.

This gentleman, upon trial, found the project of Mr. Sharp not only practicable, but much more easy to be carried into execution than in

most countries through which navigable canals have been made ; and according to his calculation a canal sixty feet wide at the surface, four feet and a half deep, and terminating in a basin four hundred feet long, and two hundred feet broad, in Moorfields, might have been completed from Waltham Abbey, for the sum of fifty-two thousand four hundred and ninety-five pounds, a sum inconsiderable in comparison to the advantages that would accrue from it to the city of London, but more particularly to the country through which it was intended to pass, every foot of which adjoining to its banks would be increased in value in proportion to its soil and situation.

Upon this representation of the facility of carrying this design into execution, Mr. Sharp thought proper to proceed, and caused a plan to be prepared and laid before the court of common council, in order to take the sense of that respectable body in a matter that so highly concerned the interests of the city. It was some time before the plan could be completed ; but it was no sooner seen than approved, and a petition was presented to parliament, for leave to bring in a bill to enable the city to carry it into execution.

Previous to this presentation Mr. Whitworth was desired to consider of the manner of conducting the canal, and of the application of it to the most beneficial purposes, as well with respect to health and ornament, as for general utility.

He was given to understand, that the quarters of Moorfields were set apart as a pleasure-ground for the citizens of London to walk in for the benefit of the air : he therefore very judiciously contrived, not only to secure to them that privilege, but to heighten the pleasure of the enjoyment, he proposed to surround the basin with a spacious gravel walk, by which any number of persons might amuse themselves by the sides of a clear stream, which no doubt would have been filled with vessels.

vessels of various construction, as none were to be admitted but boats for pleasure, except only those for carrying light goods and passengers to and from the country. For besides the smaller basin in Moorfields, which Mr. Whitworth had appropriated chiefly to pleasure, he had projected one of a more ample construction, of a circular form five hundred feet in diameter, to be laid out between the field near Holywell Mount and the tabernacle, with wharfs extending eighty feet every way from the water's edge, skirted round with buildings for mercantile purposes, which would have amazingly increased the trade of the city, and have produced many great and extensive advantages, some of which Mr. Sharp has enumerated, and which are as follows.

Health he considers as the first and greatest advantage; and that he thinks will be promoted in an eminent degree by a constant circulation of free air, occasioned by the passing and repassing of vessels for pleasure and business upon a clear stream, and by facilitating the communication with the country.

Next to health he ranks the advantage of supplying the city more copiously with provisions, the most likely means to reduce the price. Milk in particular, which is now of a very bad quality, owing to the rank food of the cows in the suburbs, would then have been brought twice a day, by water, from cows fed in meadow-lands with wholesome grass, instead of grains and cabbage-leaves.]

Butcher's meat, in like manner, would have been brought from places remote from town, where cattle would have been slaughtered without being heated with over-driving, and consequently have been fitter to be preserved in salt.

Corn, malt, and flour, at a small expence, would have been speedily brought from Ware, Hertford, Bishops-Stortford, and other towns and villages at a greater distance, without being loaded with the expence of double

double carriage ; and coals, and other heavy articles, would have been returned nearly as cheap as the same are sold in London.

Hay, straw, coals, brick, stone, chalk, lime, but more particularly timber, would have been capital articles of traffic on this canal.

The number of horses would be diminished, in proportion as the quantity of those heavy goods brought by water should be increased ; so that the saving of provender would be no inconsiderable object.

The conveyance of passengers by water, in vessels elegantly finished and decorated, from one end of the canal to the other, at the small fare of three-pence, would not only have been of great convenience to passengers in general, but more particularly to those who might be inclined to collect and bring to market the small articles of poultry, butter, eggs, &c. A large reservoir of water would always have been ready for extinguishing fires in every part in the city. By means of channels of communication, the filth of the city might all have been carried off from the common shores, at times when the abundance of rain might make water plenty. These, and many other advantages, would have accrued to the city of London from the completion of this plan.

To the proprietors of land, and to the inhabitants at a distance, the advantages would have been proportionably great. Fields would have been converted into gardens, and wastes into fertile fields, by means of the plentiful supply of manure, and the penury of the poor country labourer relieved by the profusion of the citizen.

This project, however, being opposed by certain individuals in the House of Commons, who conceived it to be contrary to their interest, was rejected, and, consequently, never carried into execution.

HISTORY OF LEEDS TO SELBY CANAL.

An Account of a navigable Canal from Leeds to Selby in Yorkshire.

THE first and most obvious advantage of a canal is, that its navigation is equal and regular; for it is not so certain that a waggoner will come to an hour at his inn, as that a boat floating on a canal will arrive at a stated time at its point of destination. The time will always be certain, and, if the canal be properly formed, will always be less than that required to navigate a river. The saving in point of time will be of the utmost importance to trade; and as the business which requires ten days in performing upon the river Air, will more frequently be done upon the canal in as many hours, if the difference in freight bear any sort of proportion to the difference in the time, the saving in that article also will be inconceivably great.

An artificial cut will be drawn with fewer curves, and will have no stream either way to oppose the vessels. By shortening the carriage, a valuable improvement will be made; and such is the improvement which the canal now projected will produce, by which, though it is only twenty-three miles in length, the passage from Leeds to Hull will become six miles shorter, and the passage from Leeds to Selby, Tadcaster, York, &c. thirty miles shorter than it now is.

In the reign of King William, when trade in this part of the country was far below its present state, it was thought proper to facilitate communication by water-carriage; and an act of parliament was passed, by which certain lock-dues, or rates of tonnage, upon the rivers Air and Calder, were granted for the encouragement of those who had undertaken to make and keep them navigable, amounting to no less than sixteen shillings per ton from the first of October to the first of May, and ten shillings per ton from the first of May to the first of October; rates
which,

which, if they were now to be exacted, would, even without the addition of freight, often exceed the price of land-carriage, and in many cases exceed the original value of the goods transported, and in a great measure put an entire stagnation to trade itself: yet these rates are now legal, and every abatement must be considered as a favour.

As the goods conveyed along the intended canal will have less length of passage, they may evidently be carried at a cheaper rate; and as water-carriage is preferred to land-carriage merely for its cheapness, the same reason makes one mode of water-carriage preferable to the other.

To mention the increase of trade in general terms, is to convey no distinct or accurate idea; it is necessary therefore to state particularly, that, by the yearly accounts of the number of woollen cloths made in the West Riding of the county of York, and given in to the justices of the Easter session 1772, it appears there were made, the preceding year, 112,370 pieces of broad cloth, measuring 3,223,913 $\frac{1}{2}$ yards, and 95,539 pieces of narrow cloth, measuring 2,377,517 $\frac{1}{2}$ yards, amounting in value, reckoning the broads at five shillings a yard, and the narrows at four shillings a yard, to the sum of 1,281,481 pounds 13 shillings; besides which it is apprehended the stuff-trade carried on in Yorkshire, and the cloth and woollen trade carried on in Lancashire, of which no certain account can be obtained, are of much greater value than the cloth made in the West Riding.

Cloth, or the materials for cloth, are not the only things in such a country that require easy and expeditious transportation. Timber, stone, coals, lime, and provisions, whatever is necessary to the support or accommodation of great numbers of wealthy and diligent inhabitants, whom successful trade always brings together, and whatever is supplied by an extensive country, very various in its products, which may be useful to other parts of the kingdom, are always passing and repassing in this populous and busy province, in which a capital of many millions is

constantly employed: and that all those would pass and repass with more certainty, and at a less price, by the canal now proposed, than by that now in use, is self-evident; notwithstanding which, the opposition it has met with from those interested in the Air and Calder navigations has defeated the project, and rendered a laudable attempt to serve the public, after a very considerable expence, of no effect.

The proposed route of this canal at once proves its utility. It was intended that it should communicate in the township of Holbeck with the canal now making from Leeds to Liverpool, pass from Holbeck by Leeds to Hunflet, and by Thwait Mill, thence cross the river Air near the fire-engines, not far from Newton, and proceed by Fairburn, with a tunnel through the hill near Burton Salmon, by Hilham and Hambleton, near Thorp-hall and Thorp-dam to Selby, into the river Ouse, which immediately falls down to Hull.

HUDDERSFIELD CANAL.

BEFORE I begin to describe the Leeds canal, it will be proper to take notice of a canal intended to go from Huddersfield in Yorkshire, to Cooper's Bridge over the river Calder, where the roads go off to Leeds and Wakefield.

This canal is to begin at King's Mill near the town of Huddersfield, and pass Bau's Lane and Townswell's Spring, crossing the high road to Hallifax, and Houghditch and Black-house Brook near Deighton, upon the edge of Ladgrave Wood, to Cooper's Bridge. The length is near eight miles, and the fall is fifty-six feet ten inches, by nine locks, equally divided for the fall. This canal was first surveyed in 1766, and again in 1773, by Mr. Luke Holt; and in 1774 an act passed to enable Sir John Ramsden, baronet, (who is the sole proprietor of the town of Huddersfield), to complete it. By its junction with the river
Calder

Calder at Cooper's Bridge, it will open a communication with the great trading towns of Hallifax, Wakefield, Leeds, York, and Hull. Stones, flates, flags, lime, lime-stone, or coals, carried on this canal, to pay eight-pence per ton, merchandise one shilling and six-pence per ton, and toll to be taken for dung or manure.

And should the canal from Leeds to Selby be completed, which there is every reason to believe it will, the county of York will then excel every county in the kingdom in the easy and expeditious manner of transporting goods from one town to another.

LEEDS AND LIVERPOOL CANAL.

A particular Account and Description of the Canal from Leeds in Yorkshire to Liverpool in Lancashire.

A navigation between the east and west seas, by the rivers Air and Ribble, was for many years deemed a practicable and desirable work by several gentlemen of speculation and public spirit; and some endeavours were used by them, at several periods, though without effect, to draw the public attention towards it. While this great design was in contemplation, his Grace the Duke of Bridgewater formed his plan of a navigable canal from Worsley Mill to Manchester; which he soon after executed with amazing ability and success. Works of genius generally draw the attention of men of genius: Mr. Longbotham, therefore, having viewed and examined this canal, and the manner of carrying it into execution, and being animated with a just spirit of emulation, in the year 1767 conceived the noble design of making a similar canal from Leeds to Liverpool; and to be thoroughly satisfied whether it was practicable or not, he took an actual survey of all the intermediate country between those two extremities, and produced a plan, with an estimate of the expence of executing it, at several public meetings, which were called at sundry times and places in the counties of York and Lancaster.

caster. At several of these meetings, composed of the gentlemen and land-owners lying near the canal, it was unanimously resolved, that the scheme was practicable; and, if executed, would be of great service to the country: and to put the question beyond a doubt whether it was practicable or not, it was farther agreed to call in Mr. Brindley to take a survey; a gentleman whose surprising success in executing works of this kind, has justly entitled him to the highest credit.

Mr. Brindley, after surveying by himself and his agent the whole course as laid down by Mr. Longbotham, reported to two numerous meetings of gentlemen, merchants, and manufacturers, held at Bradford the 5th, and at Liverpool the 9th of December 1768, that it was very practicable, and might be executed at an expence which he produced in a particular detail of all the works, and estimates of them, which is too long to particularise here, but of which the following is a summary account:

Mr. Brindley estimates the whole expence of making the proposed canal from Leeds to Liverpool, being one hundred and eight miles and three quarters, upon a plan of forty-two feet wide at top, and five feet deep, at ———— 259,777

The interest of which, at 5 per cent per annum, will amount to near ———— 13,000

The expences of keeping it in repair, the salaries of officers, losses, and other accidents, he estimates at ———— 4,000

Making together, per annum, ———— £. 17,000

And that the tonnage will at least make as follows:

Lime-stone, lime, slate, flags, bricks, and free-stone, at a halfpenny per ton per mile ———— 8,500

Coals

		£.
	Brought forward	8,500
Coals at one penny per ton per mile	— — —	3,500
Lead, iron, deals, timber, hemp, flax, Hamburg yarn, woollen, linen, and cutlery goods of all kinds, groceries, dying wares, mahogany, salt, Burslem wares, wine, spirituous liquors, corn, butter, cheese, Irish yarn, alum, &c. &c. &c. at one halfpenny per ton per mile	— — —	8,000
	Total	<u>£. 20,000</u>

These are the calculations on which this undertaking is founded; it is now to be considered, whether the advantages which may probably arise from this canal will equal the expence of making it.

The advantages which may probably arise from this canal, may be reduced to these two heads:

First, Those which will accrue to the particular county through which the canal passes.

Secondly, Those which will accrue to the whole kingdom in general.

And first, the advantages which will accrue to the particular country are:

1. It will make the mutual exchange of the native productions and commodities of one part of that country for those of another, easy, expeditious, and cheap.

2. It will greatly promote and increase the trades and manufactures carried on in it.

3. It

3. It will improve the lands, and increase population.

4. It will save an enormous expence of land-carriage.

Whoever takes only a superficial view of the intermediate country between Leeds and Liverpool, will find that some parts of it abound with the best coal, but are destitute of lime-stone, while in other parts he will find inexhaustible rocks of the best lime-stone, but a total want of coals. In others he will find fine slate, flags, and fire-stone lying neglected, and of no kind of value, on account of the prodigious expence of land-carriage, although they are much wanted along the whole course of the canal. In some parts there is great plenty of timber fit for ship-building, and great quantities of wood proper for common buildings, and making tools and utensils in husbandry, as well as for making charcoal and other purposes; while in others scarcely a single tree, unless planted for ornament, is to be seen for many successive miles.

In a great part of Craven and Lancashire, the whole country, for many miles together, consists almost solely of pasture, and a very small portion of meadow-land, and is employed in raising and feeding cattle only; insomuch that the landlords generally restrain their tenants and servants from using the plough. Their corn for bread, and every other use, they are forced to get at a very great expence by land-carriage.

From this cursory and imperfect sketch of the country it is visible, at the first glance, what general and extensive advantages will accrue to the whole adjoining country from this canal; which will, as it were, connect the whole, and make every part partake, at an easy expence, of the natural and acquired advantages and conveniences of the rest.

Coals will be carried to burn the lime-stone throughout Craven; and the lime-stone will also be carried from thence, and coal brought from the coal-works adjoining to the canal.

The

The slate, flags, and free-stone that now lie buried and useless, will be brought to light, and not only supply those parts of the country where they are wanted, but also be carried coastwise upon both the east and west seas, even as far as London, as they are now brought from the neighbourhood of Leeds and Halifax by water carriage.

Timber for ship-building, and wood for building houses, and for the various uses to which it may be applied in husbandry, and in several branches of manufactures produced by those parts where it abounds, would easily and plentifully supply the wants of other parts where at present it is scarce and dear; and Craven, and the adjacent parts, where little or almost no corn is grown, but where very great quantities are and must be consumed, will be eased of the excessive burden of land carriage, and will be constantly, plentifully, and easily supplied with that absolutely necessary commodity, by this water carriage, from the market at Leeds on the one hand, and from what is called the file country in Lancashire on the other.

These are a part, and but a very small part, of the very great and almost inconceivable benefits which will arise to the whole intermediate country, by the mutual exchanges of the native productions and commodities of one part for those of another.

2. It will contribute very much to promote and increase trade and manufactures.

We know from constant experience, that nothing contributes more to the encouragement of trade and manufactures, than the facility of conducting them, procuring the proper materials for them, carrying the goods manufactured to a market, and obtaining a certain and uniform subsistence for the manufacturers.

Now all these advantages will be derived from this canal. A constant, ready, cheap, and certain conveyance of every species of goods from one place to another, will render the management of trade easy, and will also supply the manufacturers with variety of materials; as Irish wool and yarn, cotton, indigo, dying goods, and other materials, and at the same time will provide a constant and uniform plenty of subsistence, as the market will be as it were at their own door: corn, potatoes, garden-stuff, and other provisions, will be continually passing and repassing along the canal as markets fluctuate, and the scarcity of one place or market be supplied by the superfluity of another.

3. It will greatly improve the lands, and increase the population of the country.

Lime, when used with judgment, is beyond a doubt one of the best manures for land, and by means of this canal may be had in great plenty, and at a very cheap rate, from one end of the canal to the other, and for six miles or more on each side of it, to the great improvement of this large and extensive tract of country; in several parts of which little lime can be had, while in others it is so excessively dear, on account of its being brought by land carriage, that it is but rarely and sparingly used. Besides this, marle and other manures, particularly foul salt, might also be had by means of this canal, in various intermediate parts of this country, which now cannot possibly procure them. And that population will be increased, is evident from what has been said before; for where manufactures are encouraged, where there is plenty of work, and plenty of wholesome provisions, population always must increase.

4. It will save an immense expence in land carriage.

This

This will appear evident, if the present price of land carriage be compared with the price proposed to be taken for the water carriage. The price of land carriage at present is on an average one shilling per ton per mile. The price proposed to be taken by water, for tonnage, freight, and all incident expences, is, for merchandise two-pence per ton per mile, or one sixth part of land carriage; for coals, three halfpence per ton per mile, or one eighth part of land carriage; and for lime-stone, lime, slate, &c. one penny per ton per mile, or one twelfth part of land carriage. Thus, upon a medium, at least seven parts in eight of the expences of land carriage will be saved to the public.

To how much this saving may amount, it is not easy to say with certainty; but if the profits to arise from the navigation, as is mentioned above, be truly calculated, and by those who know the country best it is deemed to be rather below than above the truth, this saving will amount to above two hundred thousand pounds a year.

Besides these advantages, there is another arising from time, or from the certainty and expedition of this mode of conveying goods and merchandises from one place to another; an advantage well understood by all traders and manufacturers. For let us suppose a proper number of deck boats, built after the manner of the duke of Bridgwater's, divided into three or four convenient rooms for passengers and merchandise, of which one should set out from Leeds, and another from Liverpool, every morning at a certain stated hour, and making short stays in their passage at certain stated times and places to take in and discharge goods and passengers, these great towns, and the whole intermediate country, would thus have a constant, safe, cheap, and commodious conveyance of goods and passengers from place to place; and the whole passage from Leeds to Liverpool, and in like manner from Liverpool to Leeds, might be completed in three days.

But advantages no less great, and by far more extensive, will arise to the trade and manufactures of this kingdom, by opening this short, expeditious, and safe communication between the east and west seas. The whole intermediate country between Leeds and Liverpool, and for a considerable extent on each side the canal, will be supplied with wool, woollen yarn, corn and provisions, hides, tallow, &c. from Ireland, and also the produce of America, and whatever else is imported at Liverpool; and the same countries will also be supplied with linen, linen yarn, tin plates, deal, timber, boards, planks, iron, hemp, flax, Russia linen, potash, and whatever else is imported from the east country at the port of Hull, and in like manner all our exports would be equally encouraged and benefited. And though this may seem to affect this country in particular, by promoting its manufactures and improving its lands; yet the whole kingdom shares in this improvement, and the encouragement of these manufactures, which annually bring into it not less than two millions sterling; besides the advantage of this internal navigation from east to west, without which vessels would be obliged to go round the island *two thousand miles or more*. In time of war, likewise, this communication will be a prodigious advantage to the whole trading interest. Upon the whole, the many advantages arising from this navigation from sea to sea are so many, and so various, and of such prodigious value to the kingdom in general, as well as these counties in particular, that it is difficult, if at all possible, to form a just idea of them.

Having taken a short view of some of the advantages which are likely to arise from this undertaking, it is necessary to consider the objections: and in doing this, the two following first present themselves; but I hope to answer them satisfactorily.

1. That such a canal will injure, if not take away the properties of those persons through whose lands it is intended to be cut.

2. That

2. That the profits of the navigation will not equal the interest of the money that must be expended to complete it.

As to the first of these objections : It is intended that the proprietors shall be, by act of parliament, particularly restrained as to houses, gardens, yards, parks, paddocks, planted walks, or avenues, or lawns inclosed, and adjoining to any house ; and as to all other lands, a full and ample consideration must be paid for them before the proprietors can cut into them ; which consideration, if the land-owners and proprietors cannot agree upon it, must be settled and determined by a jury of neighbours, assisted and directed by a number of commissioners, appointed out of the most respectable and independent gentlemen in the country, not being proprietors, nor interested in the navigation.

As to the second objection, the calculation given above, made by the most skilful and experienced men that could be employed, will be a sufficient answer.

And in order to make the expence, and raising the money, as easy as possible, it is agreed to petition the legislature to have the powers vested in a company, and to divide the capital into two thousand six hundred shares, of one hundred pounds each, to bear an interest of five pounds per cent. regularly paid on a stated day in every year till the work is completed, when the full profits shall be equally divided annually, in proportion to the shares each person is possessed of ; and that each subscriber shall have a vote upon all occasions, by himself or proxy, for every share ; and that no person shall be allowed to have more than one hundred shares ; which will be a security against any partial and injurious influence in the execution of the works, or management of the company's affairs when completed.

And as the work is calculated to be finished in eight years, and the money subscribed will be called for only as it is expended, with an interval

terval of three months between every call, the payments will rarely exceed five or six per cent. at one time, as is the practice in the Staffordshire canal; which may encourage many well-wishers to this undertaking to be subscribers, who might otherwise think it inconvenient.

The act was obtained, for carrying the canal into execution, in the beginning of the year 1770, and at the latter end of the year the canal was begun; and such was the expedition made in the work, that, at a meeting held at Liverpool by the proprietors, the 27th of September 1771, an account was delivered in by the engineer, that there were upwards of twenty miles of it not only cut, but also nearly finished. The whole completed within the time limited.

I shall now proceed to describe the course of this canal, its length, rise, and fall.

This canal begins out of the river Mersey, at low water, just at the lower extremity of the town of Liverpool, by Bank-hall, Bootle, Leatherland, and makes almost a half circle, and goes over the river Alt to Metling-chapel, by Mogul-chapel, and Aughton-chapel and Mill-house; it then takes a large half circle round the town of Ormskirk, and crosses Toad-brook near Newburgh, which it passes, and crosses also the Douglas river (which runs to Wigan), proceeds by Bisburn-hall and Monk-house, and crosses the river Yarrow at the town of Ecclestone (where the Kendal and Lancaster canal breaks out to that country). It then goes on by Shaw-green, Colebrook, and Shaw-mill to Layland, over the brook near Boomer-bridge, and near Houghton-tower and Fleetwood-hall, over the river Darwent by Showley and Dewhurst, crosses the river Calder near Whaley, by Padiham and Pendle-hall, and again crosses a part of the river near the town of Colne to Fouridge, where a basin is cut to supply the canal, of which it is the head. The canal here begins to fall to Leeds, and goes from Fouridge by Salterford, East Mertin, and crosses the river Air near Gargrave, by Thoresby, Sturton, and

and the town of Skipton, by Bradley, Kildarick, Silsden, Burnwaite, Merton-banks, near the town of Bingley; a little below which it crosses the river Air again, passes Shipley, and takes a semicircular course round Idle, near Appertin-bridge, Horsforth, Kirkstall-abbey, by Burley and Holbeck, to the town of Leeds, making in the whole a course of one hundred and eight miles and three quarters. The rise from Liverpool to the basin at Fouridge is five hundred and twenty-five feet, and the fall from Fouridge to Leeds four hundred and forty-six feet.

KENDAL CANAL TO LIVERPOOL.

A Description of the Canal proposed to be cut from the Leeds and Liverpool Canal, near Ecclestone, in the County Palatine of Lancaster, to Kendal in Westmorland; surveyed in 1772, by Mr. Robert Whitworth, Engineer.

THIS canal goes out of the Leeds canal to Liverpool, at a place called the Yarrow River, near the town of Ecclestone, and proceeds over Shaw-green to the Moss-houses, crosses the main road from Preston to Liverpool, and crosses the river Ribble near Preston; it then almost returns back, and goes over the river Savock by Lea town and Trails, to the town of Kirkham; it then forms a semicircle by Rosater and Clarkson-green, passing over Hollow-ford and the river Brock, near to Brock-bridge, and crosses the river Wyre at Garstang, over Ford-green and the river Cocker by Burrow, and close by the coast of the Irish sea to Lancaster, over the river Lune; and again running close to the Irish sea, proceeds to Hesse-bank by Sline and Botton, and over Kellet, across the river Keer near Burwick, and to the town of Burton; then by Holm, Earleton, Milton, Crooklands, over Flincafter-green, by the Forge to Natland, and into the Kent river at Kendal, near the main road to Carlisle, after a course of above seventy-two miles, and a rise of only eighty-six feet six inches, fifty-four miles and a half of it being upon a level; a circumstance not to be found in any of the inland navigations in England.

I shall

I shall say nothing of the advantages arising to trade and manufactures from this navigation, as that would be only to repeat what has before been observed: it will be sufficient to say, that whatever advantages have been expected from similar undertakings, have been experienced in their greatest extent from this.

Permit me here to make one observation on those canals which I have already described. Although it was late before we began this kind of improvement, yet the spirit with which they have since been carried on, proves the truth of the observation of foreigners, that our inventions are very confined, but our improvements on the inventions of others rapid and surprising. Whoever had suggested the idea of an inland navigation from Kendal in Westmorland to London, before the utility of inland navigations was properly understood, would have been considered as a visionary, and his undertaking would have been treated rather as the project of a madman, than the practicable design of an able engineer; and yet the latter appears to be the fact, and the thing has been effected without such an idea having at first ever entered into the minds of those by whom it was begun.

The course of this navigation is well deserving our attention.

From the extremity of this canal, at Kendal in the county of Westmorland, it is carried on by the town of Lancaster into the Leeds and Liverpool canal at Ecclestone, down to Liverpool, from thence up the river Mersey into the duke of Bridgwater's canal as far as Prestonbrook; there the Staffordshire canal breaks off, which joins the river Trent to the Severn; but the navigation to London is still carried forward by the Coventry canal, which continues the line to where the Oxford canal commences, which continues it to the river Thames, and by that river it is brought forward to London; being a course of inland navigation, reckoning all the windings, of very near FIVE HUNDRED miles extent.

If

If these vast undertakings are considered as accomplished by private adventurers, perhaps there are none such of equal extent to be found in the world (for in other countries they are generally completed by government); and yet we have no reason to believe that the cutting of canals is yet at a stand in England. There are still many tracts of country that may be advantageously connected, and which probably will be so connected in the course of a very few years. The junction, for instance, of the Nene and Avon, by a canal from Peterborough to Rugby, which would join the Nene and the Severn in a direct line, and the Nene and the Thames collaterally, is an undertaking, the expence of which would be very inconsiderable, in comparison with that of other navigations that have lately been completed.

A canal navigation is also in contemplation from Biggleswade in Bedfordshire to Hertford, to join the river Lea navigation to London.

A plan has been suggested for uniting the Lynn navigation, which already is carried to Cambridge, to the river Lea and Stortford navigations, which are now navigable to Bishop-Stortford in Hertfordshire, a distance of not above thirty miles. This might be done at the expence of about twenty thousand pounds*; and although the attempts to carry this scheme into execution have been frustrated by two noble landowners, yet the author of this history has pointed out a course which such a navigation might take, by being carried near the town of Royston, by which the trade of that great town would be easily conveyed to London, Cambridge, and Lynn, by water-carriage; and all the obstructions which this navigation has met with from those noblemen, and from the town and university of Cambridge, who opposed the last petition presented to parliament in 1790, will be entirely

* See a Treatise on Inland Navigation by the author of this history, printed in 1785, by Hooper, Holborn, containing a plan for a canal to be cut from London through the interior parts of the counties of Essex, Suffolk, and Norfolk, to the city of Norwich, and to Lynn; and for extending the navigation from Bishop-Stortford to Cambridge.

avoided; and as its utility cannot but be manifest, I make no doubt there would then be more petitions in its favour than there were before against it.

But not to confine myself to England; the countries of Scotland and Ireland are also improving by canals, as is likewise Wales. An act of parliament was very lately passed for a canal from Cardiff to Merthyr Tidvill, a distance of twenty-five miles; and an application is intended for another act, for a canal to be cut from Neath to Furno Vaughan, being thirteen miles.

I am also willing to entertain hopes that government will undertake the cutting of a grand canal from the river Thames to Southampton, and consequently to Portsmouth, by which a certain and expeditious communication from the metropolis, and the dock-yards of Chatham, Sheerness, Woolwich, and Deptford, with that at Portsmouth, may be obtained, without ships being obliged to go round the Foreland, the Downs, and Down Channel, against tempestuous or adverse winds, in time of war; and the convoy which is employed on that service, may be used for other purposes, such as the victualling the fleet at Spithead. Stores and all other articles may also go by this inland navigation.

And as the course of a canal has been surveyed and found practicable from Andover to Redbridge, and that of another from Basingstoke to Weybridge in Surry, and the Thames (which I shall next particularly describe), and which has been objected to by some interested persons, I would wish these also to be undertaken by government; for no private inconvenience should stand in competition with the public good, especially as a proper value is paid for the land taken away. This canal, should it ever be completed, will, I hope, be sufficiently broad and deep to admit of large vessels of burthen, that will bear both tide-ways, without shipping and transhipping, which is both troublesome and expensive. Then may we expect to see the noble oak timber growing in the
internal

internal parts of Hampshire and other adjoining counties, and which is now almost useless on account of the heavy expence attending conveying it to the dock-yards, brought by cuts branching from the grand canal, by a cheap and ready conveyance, to places where the want of it has been for some years severely felt.

BASINGSTOKE CANAL.

An Account of the intended navigable Canal from Basingstoke in Hampshire, to the River Wey near Weybridge, in the County of Surrey.

A CANAL from Basingstoke was first proposed in the year 1772, and a petition was then presented to parliament ; but it was not intended that it should communicate with the river Wey near Weybridge, but with a canal that was then proposed to be made from Reading to Monkey Island, near Maidenhead, in the river Thames, by the corporation of Reading, and from thence to be continued by the corporation of the city of London to the river Thames at Isleworth ; but through the opposition of the land-owners, and other landed gentlemen, who had not discernment enough to see their own interest, the whole scheme was frustrated.

But the plan now offered meets with a more favourable reception from the land-owners ; for out of the great number of the different proprietors of land through whose grounds this canal is to pass in a course of forty-three miles and three quarters, there are but two dissenting voices.

This canal promises to be of great public utility, by furnishing an easy conveyance to the London market, and to the public dock-yards for vast quantities of timber, which at this time lies useless in the country for want of such conveyance.

This canal is to begin at Basingstoke, from the little river Loddon, and at a place called Newman Springs, by the village of Basing; thence it is to pass round and across the road at Newham, and take a sharp turn round Tilney-hall and park, down almost back again to near the town of Odiham, into the little river called Deepford; whence it will proceed round Degmersfield-park to near Crookham, straight along by Aldershot, over Dead-brook, which divides the counties, and thence turn up to Colingley-moor, and return by Purbright and Oak-farm into the river Wey, near the little village of Westley. Its length will be very near forty-four miles.

ANDOVER CANAL.

An Account of a navigable Canal proposed from the Town of Andover to Redbridge, near the Town of Southampton, in the County of Hampshire.

THIS canal was surveyed in the year 1770, and found to be practicable and easy, and in 1771 a petition was presented to parliament for leave to bring in a bill to carry this useful scheme into execution; but nothing has yet been done, on account of some objections being made about the lands to be purchased, and the damages that might be sustained by particular persons, although the advantages that would accrue to the kingdom in general, and this part of the country in particular, are very considerable and apparent, not only from the general reason of the thing, which I before have mentioned (for trade will always find its way where there are conveniences for it), but also from a well-known fact, that before the navigation was made at Newbury, the markets at Andover were very large, and a very great corn-trade was carried on there; but from that time it has declined, and is now in a manner lost, insomuch that the farmers carry their corn even from thence to Newbury; but when the proposed canal from this place to Redbridge shall be made, the trade will of course return to its old channel, especially as
it

it will open a more easy and cheap communication with London and Bristol ; so that as the Newbury navigation took the trade away from Andover, this new canal will effectually restore it, and new sources of trade will most probably be discovered.

This canal was to begin at Barrow's Mill, and take in Pillhill Brook, proceed by Upper and Lower Clattford, Westover, and round the village of Fullerton, at Kitcomb Bridge, by Lakeford, and through the town of Stockbridge, by Park Farm, Mitchimus, and Tinsbury, by Great Bridge to the town of Rumsey ; and thence cross the great road from Salisbury to Winchester and Lower Ashford, by Grove-place and street to Red-bridge into the Hampton-water ; being a course of twenty-two miles and a half, and a fall of one hundred and seventy-six feet nine inches.

WINSTON CANAL TO STOCKTON ON TEES.

An Account of a navigable Canal from the Town of Winston, on the River Tees, by the Town of Darlington to Stockton, on the same River, all in the Bishopric of Durham.

THIS canal was surveyed in 1768 by Mr. Robert Whitworth, and was intended to have been carried into immediate execution ; but a sufficient subscription could not then be raised, it being feared that the tolls for the goods that were likely to be carried upon it would not pay the subscribers sufficient interest for their money ; but these apprehensions have been so satisfactorily answered by some gentlemen who are well acquainted with that country, and have made calculations of the prodigious quantities of coals, lime, and lead, besides other merchandise that would be carried upon such a canal, that it is now beyond a doubt that it would pay the undertakers as well as any canal made or now making in the kingdom, that of Birmingham only excepted (the tonnage of which amounts to more than eleven thousand pounds per annum) ; and it is not clear whether it would not even exceed that.

The

The course of this canal is to go out of the river Tees at or very near Winston, and running north to very near Staindrop, turn westerly to Kitterby, by Legg's-crofs to near Lower Walworth; from thence by Cockerton to Darlington, and crofs the high road to Durham, and also crofs the river Skearn; and thence to Bank-top, and along Maiden-dale to the Fighting Cocks near Oak-tree and Moor-house by Cotham-Stob and near Hartburn, into the river Tees at the town of Stockton; being a course of near twenty-seven miles, with a fall of three hundred and twenty-eight feet.

There is to be a branch from the main canal, near Lower Walworth, to Pierse-bridge into the Tees, of one mile and three quarters; and another cut from Darlington to Croft-bridge on the Tees, of three miles; and another cut from Cotham-Stob to Yarm, of near two miles; which together, when finished, will make the completest canal in the kingdom.

CHESTER CANAL.

An Account of the navigable Canal from the City of Chester to Middlewich, and into the great Staffordshire Canal near that Town; and also of the Branch to Nantwich.

THE course of this canal was surveyed in the years 1767 and 1769, and again in 1770, by several surveyors and engineers; and at the latter end of the year 1769, application was made to parliament, for an act to complete the same, by the corporation and gentlemen of Chester; but at that time their petition was not attended with success. In the latter end of the year 1770, application was again made to parliament, and an act obtained, but with this extraordinary restriction, that the intended canal should not unite or communicate with the Staffordshire canal at Middlewich. The canal was begun in April 1772, and completed in a very short time, and is productive of great advantages to the city of Chester, and also to the country through which it passes.

The

The course of this canal is out of the river Dee at Chester, across the main road leading to Warrington, by Christleton and Waverton, Hargrave, Hexley, and over Brassey-green, near Beeston-castle, to Tiverton; and about two miles and a half further, nearly due west, it turns to nearly northerly by Calmton and Page's-wood, over Lea-green, and by Lea-hall and Clive-green, over the little river Wallage to Middlewich. The branch that goes off about two miles and a half from Tiverton, turns, to the right, south-west to Hurleston, Acton, and Nantwich; going a course, with the branch, of twenty-six miles and three quarters. Its rise from Chester, to where it branches to the right and left, is one hundred and seventy feet ten inches, and the fall to Middlewich is just forty feet: from thence to Nantwich is a dead level.

BIRMINGHAM CANAL.

An Account of the Birmingham Canal to the River Severn, or rather into the great Staffordshire Canal, at Aldersley near Wolverhampton, in the County of Stafford; surveyed in 1774, and carried into immediate execution.

THIS canal begins at Birmingham, and proceeds to Winson-green and Smethwick, by Blue-gates, West Bromwich, Oldbury, over Puppy-green, by Church-lane, Tipton, and Bilston; by the skirts of the town of Wolverhampton, and by Gosbrook-mill into the canal from the Trent to the Severn at Aldersley; being a course of twenty-two miles and a half, with a rise from Birmingham to Smethwick of thirty-six feet, and a fall from Smethwick to Aldersley of one hundred and fifty feet eight inches. Out of this canal, at West Bromwich, there is a cut or branch which passes over Gut's-green, Ryder's-green, and Brick-house-lane, to the collieries at Wednesbury; being four miles and three quarters, with a fall of thirty-six feet.

The

The other canals to the several coal-mines and towns were surveyed in 1775. A canal commences about a mile from the town of Dudley, near the engines which are next Netherton-hall, and proceeds across Knowl-brook, and along Dudley-wood side, through Urchill-coppice and Brierly-hill coppice to Black Delft, and, taking a large circuit round Brierly-hill church, and across Brittle-lane, between the fire-engine and Seaton's engine, falls into a canal on the left of Brockmore-green, which comes from the right from Bromley-fenns and Pensnett-chace, where there is a large reservoir of water, for a head to the navigation, of near twelve acres. It thence proceeds almost in a straight line to Wordsley, across the high road from Stourbridge to Hampton, along Wordsley-field, and across the river Stour, which runs up to Stour-bridge, and runs on the left by Bell's-mill, through Affcott-meadows into the grand trunk, at thirty-four miles from the Trent navigation, and twelve miles from the Severn. At the elbow and confluence of the river Stour with the river Smeftall, very near Stourton, a branch goes off to the left by Wordsley-field, along Addenham-bank, by Woollaston, Holloway-head, round Sot's-hole, into the river Stour, at the extremity of the town of Stourbridge. The distances and falls are as follows:

From the junction of the Wolverhampton canal to that of the Dudley canal, five miles, and the rise one hundred and ninety-one feet three inches; the branches to Stourbridge and to Pensnett reservoir are two miles one furlong, and level; from the Wolverhampton canal to the reservoir on Pensnett-chace the distance is six miles one furlong, and the rise one hundred ninety-one feet three inches; from Stourbridge to the branch of the reservoir, one mile and a quarter, and level.

LANGLEY BRIDGE CANAL.

Account of a navigable Canal from Langley Bridge, in the County of Derby, to the River Trent, near Sawley Ferry, in the County of Nottingham.

AT the time when the navigable canals were making in the interior parts of the country, it was proposed by the gentlemen and owners of the extensive coal-mines in the neighbourhood of Heaner, Langley, Eastwood, Awsworth, Coffaw, Ilkinston, &c. to carry their coals to the river Trent, which, for want of a water-conveyance, lay useless both to the owners and to the public. Accordingly a survey was made, a plan drawn, and an estimate of the expence made, in 1776; but it was not till 1777 that an act was obtained for carrying the scheme into execution.

This canal passes by all the above coal-works or mines, and is carried over Nutt-brook, by a water-bridge or aqueduct, to Stapleford and Sandy-acre, and across the main road from Nottingham to Derby, and by Long Eaton into the river Trent, nearly opposite where the branch to the river Soar takes its departure, and not far from Sawley-ferry; after a course of eleven miles and three quarters, with a fall of one hundred and eighty feet eight inches.

CHESTERFIELD CANAL.

A particular Description of the navigable Canal from Chesterfield, in the County of Derby, to the Trent at Stockwith, in the County of Nottingham, below Gainsborough.

THAT able and experienced engineer, the late Mr. Brindley, in the year 1769, projected this canal, surveyed the ground, and delivered in an estimate of the sum requisite for its completion, which he stated

M m

at

at one hundred thousand pounds. The plan met with general approbation, and an act of parliament was obtained for carrying it into execution in the spring of 1770; and notwithstanding the act prohibited the proprietors from beginning the work till the sum of one hundred thousand pounds was subscribed, this canal was conceived to be of such great utility by the gentlemen, land-owners, and owners of coal-works, that that sum was subscribed as soon as the contents of the act were known. The work was therefore immediately begun, and carried on under the direction of Mr. Brindley to the time of his death, and since that time continued and completed by Mr. Henshall. In the course of this canal, the engineer has had numerous difficulties to encounter; the principal of which is in the neighbourhood of Hartshill, where the canal is carried under ground for near three thousand yards.

This canal is of inestimable advantage to the neighbouring country, in conveying coals, lead, stone, lime, and other heavy articles; which are now carried at one fifth part of the usual price of land-carriage, and with equal expedition. It has also produced to the subscribers a profit exceeding their most sanguine expectation, notwithstanding some discontented persons had pretended to foretell, that the trade carried on upon it would be so trifling that it would not pay the subscribers common interest for their money.

The course of this canal begins at Chesterfield, and proceeds by Rickett's-mill, near Staveley-forge, by Staveley-town and coal-works, the Hague, and near Eckington and Killmarch, to the beginning of the tunnel at Hartshill; and at the length of three thousand yards comes out again near Peck's-mill, and proceeds then by Shire Oaks to Work-sop, across the Royton river at Kilton. It thence takes a circuit to near Bilby-hall, and round again to Balworth, and all round the town of Retford, except a very short space; and then turns from the southwest to due north, and passes by Welham, Charleborough, Clowarth, and, round Grindley on the Hill, to Misterton, into the river Trent, near Stockwith;

Stockwith; after traversing a course of forty-four miles and three quarters, with a rise of forty-five feet from Chesterfield to Norwood, and a fall of three hundred and thirty-five feet from Norwood to the river Trent.

BUDE CANAL TO LAUNCESTON.

Extract from an Act of Parliament, passed in 1774, for making a navigable Cut or Canal from the Port or Harbour of Bude, in the Hundred of Stratton, in the County of Cornwall, to the River Tamer, in the Parish of Calstock, near the Town of Launceston, in the said County.

THE act nominates thirty trustees for completing the canal, by the following course: From the port or harbour of Bude, in the parish of Marham Church, in the county of Cornwall, through the several parishes of Marham Church, Pounds-toke, Flyke, St. Mary Whitestone, Launcells, Bridgerule, North Tamerton, Boyton, Werrington, North Pitherwin, Tremain, Egleskerry, St. Thomas, St. Mary Magdalen, St. Petherwin, Trewain Laneast, Alternon Lawanick, North Hill, Linkintrom, Stoke Clemfand, and Calstock, in the counties of Cornwall and Devon, to the river Tamer in the parish of Calstock, in the said county of Cornwall.

The powers of the proprietors are next ascertained, which are similar to those granted by other acts of the same kind. A particular clause states, that the cut or canal be carried under ground, and arched over so as to support the ground lying thereon, for a space of three hundred feet, near to the mansion-house of Whiteford, in the parish of Stoke Clemfand. The land to be used for the canal, not to exceed sixty-three feet in width, towing-paths included, except for making a dock or basin; nor to be of a greater depth than thirty-nine inches from the present level or surface of the ground; and in such places where it shall be judged necessary for boats and other vessels to turn, lie in, or pass each other, or where any engine or crane may be erected, not above twenty

poles in breadth. Bodies politic or corporate empowered to sell or exchange lands. Commissioners appointed to settle differences; and if they cannot agree, a jury to be appointed. Persons guilty of perjury, to be prosecuted. Persons wilfully destroying or obstructing the navigation, engines, &c. to be adjudged guilty of felony. Mines and minerals to belong to the lord of the manor. Proprietors to make drains and watering-places for cattle. Towing-paths to be fenced in. No wharfage to be paid for goods or merchandise that shall not lie longer on the wharfs than twenty-four hours; and no more than two-pence per ton be taken for wharfage of coals, stone, sand or bricks, nor more than three-pence per week per ton for the wharfage of any other goods and merchandise. Proprietors may raise the money among themselves to make the cut or canal, not exceeding forty thousand pounds, to be divided into four hundred equal shares of one hundred pounds each; and no person to have more than twenty shares, and to have a vote for every share; and if the sum of forty thousand pounds is not sufficient to complete the said canal, the proprietors are empowered to borrow twenty thousand pounds more, or admit new subscribers to that amount. The canal-duty for every ton of slate, stone, sand, culm, coals, timber, or any kind of manure or fuel, not to exceed two shillings, nor three for every ton of any kind of goods, wares or merchandise; and so in proportion for any greater or less quantity than a ton. Commissioners may lessen or advance the tolls. With respect to timber, forty feet of round, or fifty feet of square oak, ash or elm, or fifty feet of fir or deal, balk, poplar, and other timber-wood, shall be deemed one ton weight; and twenty hundred, avoirdupois, to be deemed and taken for one ton of stone, lime-stone, bricks and coals. The navigation to be free on payment of the rates. The company of proprietors restrained from leasing the canal or tolls, or from being concerned in any vessels carrying goods for hire, under the penalty of fifty pounds. Names of owners to be put on the boats; and masters or owners to be answerable for damages. Penalties of five pounds to be levied for wilfully opening swivel or draw-bridges to interrupt travellers; and a penalty of five pounds
for

for every instrument to destroy fish. Proceedings to be without stamps. If the company do not finish the canal in ten years, or discontinue it for five years, the owners may have their lands again, if they choose to purchase them. Persons aggrieved may apply to the quarter-sessions.

This canal, according to the best information I have been able to procure, is not finished; because the chief commodity of traffic would be coals from Wales; on which account, though coals are very much wanted on the whole length of the canal, the subscribers are fearful of undertaking it.

CANAL FROM MARKET WEIGHTON TO THE HUMBER,

In the East Riding of Yorkshire.

Extract of an Act passed in 1772, for draining and preserving certain Commons, low Grounds and Cars in the Parish of Market Weighton, and other adjacent Parishes in the East Riding of the County of York; and for making a navigable Cut or Canal from Market Weighton to the River Humber.

THE preamble to this act is as follows: Whereas certain commons, low grounds and cars, within or near the villages, townships, or parishes of Market Weighton, Blacktoft, Everingham, Harfewell, Seaton, Rofs, Holme upon Spalding-moor, Froggathrope, Gribthrope, Spaldington, Bursea, Hasholm, Wholsea, North Cliffe, South Cliffe, Hotham Houghton, Bromfleet, Faxfleet, Shipton, Sancton, and also a certain common called Walling Fenn, containing twenty thousand acres, are subject to be overflowed, and unprofitable to the proprietors: and whereas the draining of the said commons, low grounds and cars, and the making the main principal drain navigable from the river Humber, at or near a place called Fossdike Clough, situate on the banks of the said river, will be of great utility to the public; but the same cannot be effected without the aid of parliament: May it therefore please your Majesty, &c.

This being an act for draining a large tract of country of twenty thousand acres or more, as well as for making a navigable canal, it necessarily differs from the canal-acts in general. The extract I shall make shall be as short and concise as possible.

The act sets out with naming commissioners for draining the said lands, and cutting the canal; and then nominates a great number of trustees for the drainage and navigation. No person to be a trustee who shall not advance a sum not less than two hundred pounds for the purposes of the navigation. Commissioners interested in the commons, low grounds, or cars, incapable of acting. Commissioners to have one general annual meeting. Trustees to have no place of profit, and to defray their own expences. Commissioners may make cuts and drains, and maintain the same, so that no water flowing from Londesbrough into the Foulney be diverted or turned into the said navigable canal, before the same water shall have entered the Foulney. Bridges, gates, stiles, fences, passages and tunnels to be made and kept in repair. Commissioners to settle all disputes, and determine boundaries of commons. Several dams to be taken away, or kept up, at the commissioners choice. The commissioners shall begin the navigable canal at or near Fossdyke Clough, situate on the banks of the river Humber, and finish and complete the same progressively upwards to Market Weighton. The works for the navigable canal not to prejudice the drainage. No lock to pen up the water higher than three feet of the natural surface of the land. Owners and proprietors of commons, low grounds or cars, may, at their own costs, cut drains or canals, in, on, or over their own grounds, so as not to prejudice the main canal for navigation. Tolls to be taken, not exceeding four shillings for every ton of grocery goods, wares and merchandises; two shillings for every chaldron of coals, containing thirty-two bushels; one shilling and six-pence for every chaldron of lime of thirty-two bushels; one shilling for every ton of stone; six-pence for every ton of manure of all sorts; two shillings for every thousand of tiles; one shilling for every thousand of bricks; and eight-pence for every pack

pack of wool, containing sixteen stone to each pack; to be paid in proportion of the distance; the whole being payable from the Humber to Market Weighton. No tolls to be paid by boats for pleasure, or vessels laden with materials for the purposes of drainage or navigation. Commissioners may compute the charges of drainage and navigation respectively, and allot each proprietor his share of the tolls. Commissioners, after the works are completed, to divide and arrange the number of acres of each proprietor into different species of land, and tax accordingly. Taxes may be laid, to maintain the works. A further subscription, if wanting, to be raised without restriction, by admission of new subscribers, or among themselves. Trustees to appoint officers. Officers not accounting to be liable to a penalty. Boats to be measured, numbered and marked. Masters to be answerable for damages done by the crews. Navigation to be free, upon payment of rates. Tolls exempt from taxes. Breaking locks or gates, or damaging the works, to be felony. Exemption granted from stamp-duties.

This canal is finished, and turns out greatly to the advantage of the land-owners and proprietors, not only in draining the lands, but by facilitating the carriage of the produce and manufactures of a large extent of country, which before were carried at a very great expence by land-carriage.

SIR NIGEL GRESLEY'S CANAL.

In the year 1775, an act was granted to enable Sir Nigel Gresley, bart. and Nigel Bowyer Gresley, esq. his son, to make and maintain a navigable cut or canal from certain coal-mines in Apedale to Newcastle-under-Line, in the county of Stafford.

The preamble of the bill is as follows: Whereas Sir Nigel Gresley, baronet, and Nigel Bowyer Gresley, esquire, son and heir-apparent of the

the said Sir Nigel Gresley, are proprietors of several considerable mines, rows and veins of coal, situate within the manor of Apedale, in the county of Stafford: and whereas the making a navigable cut or canal from the said coal-mines to Newcastle-under-Line, in the said county, will be of particular advantage to the inhabitants of the said town, and parts adjacent, and of public utility: and whereas the said Sir Nigel Gresley and Nigel Bowyer Gresley are the proprietors of a considerable part of the land through which the said cut or canal is proposed to be made, and are willing and desirous, at their own expence, to make and maintain such cut or canal: May it therefore please, &c.

Then follow the usual clauses of all navigation acts. The width of the canal and towing-paths, and the ditches, drains and fences, not to exceed twenty-six yards, except in such places where the said cut or canal shall be raised higher, or cut more than — feet deeper than the surface of the land; and in such places where it shall be judged necessary for boats and other vessels to turn, lie, or pass each other, or where any crane may be erected, not to exceed sixty yards. The proprietors are also to engage to deliver coals from their coal-mines as aforesaid, at the town of Newcastle-under-Line, to the inhabitants thereof, at the price of five shillings for each ton of twenty hundred weight of six score pounds avoirdupois weight, for a term of twenty-one years; and for five shillings and six-pence per ton for a further term of twenty-one years after the expiration of the said first mentioned term, and so in proportion for any greater or lesser quantity than a ton. And they also oblige themselves to keep a stock at their wharf at or near the said town of Newcastle, for sufficient consumption of the town and its inhabitants, under a penalty of forty pounds; and if any of the inhabitants want a less quantity than a ton, they are to be delivered to them at three-pence halfpenny per hundred weight of six score. A clause is also inserted, that the commissioners, on proof of great expences, &c. may

may raise the price of coals, the second term of twenty-one years, to six shillings per ton.

EARL OF THANET'S CANAL.

IN the year 1773 an act passed to enable the right honourable Sackville earl of Thanet to make a navigable cut or canal from a place called the Spring, lying near Skipton Castle in the county of York, to join and communicate with the navigable canal from Leeds to Liverpool, in the close called Hebble End Close, in the township of Skipton, in the said county of York.

The preamble to the act sets forth, that whereas the owners and occupiers of land, and others the inhabitants at or near Leeds, Bradford, Bingley, Keighly, Sillsden, and other places lying contiguous to the said canal, have occasion for, and frequently are in great want of lime and lime-stones for the improvement of their lands and other purposes; and the right honourable earl of Thanet is possessed of grounds near the castle of Skipton aforesaid, in which are great quantities of lime-stone rocks, and which are situate within the distance of five hundred and thirty yards or thereabouts from that part of the canal which lies nearest to the town of Skipton; and whereas it is very practicable to make a navigable cut or canal for the navigation of boats and other vessels from the aforesaid spring of the earl of Thanet which joins to the lime-stone rocks, through the lands, grounds and wastes of the said earl, and other land belonging to the free grammar-school at Skipton aforesaid, to join and communicate with the said navigable canal from Leeds to Liverpool at a place called Hebble End Close, in the township of Skipton; and whereas to accommodate the aforesaid towns, places and inhabitants, as also the adjacent country, with lime and lime-stone from the said lime-stone rocks, the said earl is desirous of cutting a canal at his own expence, and to keep and maintain the same, together with the roads and

N n

towing-

towing-paths ; but the same cannot be effected without the aid of parliament ; be it enacted, &c.

The act is very short ; the canal going entirely through his lordship's grounds, except Hebble's-close-field, which belonged to the free grammar-school at Skipton. Arbitrators were appointed for the said purchase ; and the act provides, as usual, for the making of bridges, towing-paths, aqueducts, tunnels, &c. &c. &c.

W A L E S.

W A L E S is capable of great improvements by canals, but has been long neglected for want of proper encouragement. Her mines of coals, copper, lead, iron-ore, and others of less consequence, are inexhaustible ; and the contents of her mountains, even in this enlightened age, are still unknown. The valuable timber which this country produces, although so much wanted for ship-building, decays as it stands ; and the produce of the mine, in many places, lies in its natural state for want of a proper conveyance to a market. The improvements made by canal navigations in the counties bordering on the noble river Severn have roused, at last, a laudable spirit of adventure in the gentlemen land-owners in a part of South Wales, which beyond a doubt will be crowned with success, and create an emulation for improvements in other parts of the country, equally capable of them. And although this kind of improvement is as yet but in its infancy, it is to be hoped it will meet with proper encouragement from those whose interest it is to promote the welfare of their country ; since by so doing they promote their own. And although the canal I allude to is the first that has been cut in Wales, I hope it will be found so advantageous to the proprietors as to induce others to follow their example.

An act was passed in 1790, for cutting a canal from Cardiff to Merthyr-

thyr Tidwell, being a distance of twenty-five miles. It is to begin at Pennarth, near Cardiff, and to pass Llandaff and Pielly-bridge to Merthyr Tidwell, and will take in those iron furnaces which are already at work : new ones will also be erected. As a conveyance to a market for such heavy and bulky articles was all that was wanting, the mines of coal, and rocks of lime-stone which before lay useless to the owner, will now find, by this ready conveyance, a proper consumption ; and improvement will be extended still further into the country. But as this canal is only just begun, the profits and advantages are at present only speculative ; although the greatest benefit and utility may be expected from the undertaking, which is now carrying on with the utmost vigour, near two hundred men having been set to work on it immediately after the act had passed.

Another canal, from Neath to Furno Vaughan, is not only in contemplation, but a bill is prepared, and ready to be presented to parliament, for leave to cut a canal, which will be equally advantageous with the former. The length of this canal will be about twelve miles ; and it may justly be expected that it will prove of the greatest utility. Iron-works will be erected, mines of coals will be opened, and rocks of lime-stone removed ; all of which will be rendered advantageous to the proprietor, and useful to the neighbouring country.

Two small canals through private property have been already cut, to the great emolument of the proprietors : one of them from near Swansea through a morass to Meath ; nearly three miles. The other from the town of Kidwelly to a mine of coals and a mountain of lime-stone, in the estate of a Mr. Keymer, at whose expence it has been cut. It is between three and four miles in length ; and at the same time that it enriches the worthy land-owner, is of the utmost utility to the inhabitants of that and of the neighbouring country.

C H A P. XII.

Account of the Canal from the Forth to the Clyde, in Scotland.—Such a Canal proposed in the Reign of Charles II.—Begun under the Direction of Mr. Smeaton in 1768.—Collateral Canal cut from the grand Canal to Glasgow.—The grand Canal completed in 1790, under Mr. Robert Whitworth.—Extracts from a Pamphlet on the Navigation between the Rivers Forth and Clyde.—Account of the Length, Rises, Falls, Locks, Tonnage, &c. on the grand Canal.—Account of an intended Canal between Loch Gilp and Loch Crinian.—Account of an intended Canal between Inverness and Fort William.

S C O T L A N D.

FORTH AND CLYDE CANAL.

THE scheme for joining the two rivers, Forth and Clyde, was originally proposed so long ago as in the reign of Charles II. It was revived again in 1723, and a survey was made by a Mr. Gordon; but, on account of the magnitude of the undertaking, it was again laid aside. In 1762 lord Napier employed Mr. Robert Mackell to make a survey and estimate of a canal, which should leave the river Clyde at Yocker Burn, about five miles below Glasgow, and join the Forth within about two miles of the mouth of the river Carron.

Encouraged by Mr. Mackell's favourable report, the board of trustees for the encouragement of the fisheries and manufactures in Scotland, employed Mr. Smeaton to make a survey, which he did in 1764; but the expence appearing too great, it was judged the trade would not be
adequate

adequate to the payment of the money necessary to complete the work.

Messrs. Mackells and Watt were therefore employed to project a small canal from Glasgow (from whence it was judged that most of the trade would arise) to the river Forth. Their report and estimate were published in London in 1767. The country gentlemen disliking the idea of a small canal to terminate at Glasgow, Mr. Smeaton was again desired to re-examine the ground, and to give his report on a large canal, such as would carry the common coasting vessels quite across from sea to sea; as they rightly judged, that by such a canal a very considerable trade would be promoted between the west coasts of Great Britain and the east coast of Ireland.

Some difference in opinion having arisen between Mr. Smeaton and some friends to the project, Messrs. Brindley, Goldborne, and Yeoman, were called in, and gave their opinion on the subject, which was afterwards reviewed by Mr. Smeaton, who so completely refuted the arguments of those gentlemen, that the proprietors, sensible of his superior abilities, put the whole under his direction. A subscription was accordingly set on foot, and an act of parliament obtained to carry the plan into execution.

A short extract from Mr. Smeaton's report to the honourable the trustees for fisheries, manufactures, and improvements in Scotland, relative to the practicability and expence of joining the rivers Forth and Clyde by a navigable canal, cannot but be acceptable to the reader.

“ The great utility of a navigable canal, or communication between the east and west seas, has given occasion to the forming of several projects for this purpose in different parts of the kingdom of Great Britain; the principal of which are, the junctions of the Thames with the Severn; the

the Trent with the Severn; the Trent with the Weaver; the Calder with the Mersey; and the Forth with the Clyde: but from what I have seen and heard of these matters, I am well convinced that by far the easiest to be accomplished, not only in point of distance, but in point of perpendicular height, is the last: and it is somewhat remarkable, that notwithstanding the country at this place lies in general as high, if not higher, than any of the rest, yet through this high ground there happens to be two different passages, both lower than any of the others, and both of which have so great an appearance of equality in point of practicability, that upon ocular surveys it has remained a doubt which of the two ought to be preferred.

“ One of these passages is from the river Carron, by way of the water of Bonnie, through the bog of Dolater into the Kelvin, and from thence into the Clyde, by the way of the Yocker Burn.

“ The other is by following the river Forth some miles above Stirling, and then crossing over through the bog of Bollat into the water of Enrick, down to Loch Lomond, and from thence by the river Leven into the Clyde at Dumbarton; and as I have, by order of the honourable the trustees for fisheries, manufactures and improvements in Scotland, been at some pains in taking proper observations, in order to determine the preference of these two passages, I shall first endeavour to settle this question, and then proceed more minutely to explain the several leading points that occur in laying out the design for the preferable tract.

“ From the Forth, about three miles up the river Carron, to a place called Carron Shore, there is at present a good navigation for sea-vessels drawing from nine to ten feet water at spring-tides, and from seven to eight feet water at neap-tides; which, from the cuts proposed to be made across the loops, as I am informed, is likely to be improved: and
so

so far I consider the present sea-navigation to extend. From Carron Shore to Top-hill, a little below Camelon-bridge, the ground is gently rising, and accommodated as well as possible for a canal. From thence to the point above Camelon, between New-hall and Glenfour, the ground rises near sixty feet in half a mile, and is more uneven, but yet attended with no considerable difficulty. From thence the canal may be managed, upon the decline of the high ground, so as to run upon a dead level to Castle Cary-bridge; being four English miles. This tract of ground is intersected with haughs and burns, which occur very frequently, and will therefore require a considerable expence in making banks, aqueducts, and other extra works; yet nothing occurs but what may be conquered at a reasonable charge. The principal single work will be an aqueduct-bridge in crossing Bonnie Mill Burn, near Bonnie-bridge, over which the canal must be carried by arches. Another, but lesser, work of the same kind will be required in crossing the river Bonnie, at Castle Cary-bridge. From hence, by the bog of Dolater, which begins a little above Wineford, the passage is sufficiently easy, by a gentle ascent; and through the said bog (extending almost to Craigmartine woods) there is scarcely four feet descent, either way, in the compass of two miles, about the middle of which is the summit between the two seas, which is elevated above high water neap-tides at Carron shore, about one hundred and forty-seven feet; being distant from it about nine English miles. On each side of Dolater-bog the country rises high, which affords a number of springs and rills, that bring down considerable quantities of water on the least rain; but the principal, which is constant all the year, is the burn of Auchinclough, which discharges itself into the bog, and which, though it now runs into the water of Bonnie, might with very little trouble be turned so as to run the other way into the Kelvin; for a drain that now passes length-ways through the bog has, for half a mile in the middle of it, no sensible run at all; so that the same trench is the head both of the Bonnie and Kelvin. This bog, as it is called, is properly a peat moss, or morass, and is in general near half a mile broad, but contracted at each end to about one hundred

and twenty yards; so that it is adapted, as well as possible, for the formation of reservoirs, canals, and passages for water: indeed the whole bog might be easily put under water, by a small dam between the high grounds at each of the contracted places.

From the summit, or point of partition, westward, the Kelvin runs in an open valley, for about thirteen miles, upon a very regular, and almost insensible decline, as far as Gariscud-bridge, where it begins to be very rapid, and runs through a very deep channel, quite confined by rocks and precipices, in some places almost perpendicular, down to Partick, where it falls into the Clyde. Of this district all that can be said is, that it is not impossible to be made navigable; but it would cost a great sum to make a bad navigation; for this reason, those who have turned their thoughts towards this project have sought out a new passage into the Clyde; and nature has kindly furnished two practicable ones; one by the valley of the Allander, leaving Douglastoun, Kilmar-dony, and New Kirk-Patrick, all on the right, and cutting through a rising ground between the two last places, into a valley leading down to Grascaldon. The other passage leads out of the Kelvin's valley, just above Gariscud-bridge, and, going by way of Canny's-burn, traverses a rising ground, and falls into St. German's loch, and from thence, by the same valley as the former, to Grascaddon. Neither of these passages is without difficulty, on account of the rising ground to be cut through being above thirty feet perpendicular above the general level; yet both are greatly preferable to the passage by the Kelvin, below Gariscud-bridge, which, besides the difficulties already mentioned, is filled with mills of various kinds, that occupy the ground where any cuts might conveniently be made. At Grascadden the ground falls considerably in a little space, and then the passage is very easy and regular down to Yocker-burn, which discharges itself into the Clyde, almost opposite Benfield, and a little above a place called Barn's of Clyde. From hence, downwards, the Clyde is navigable at all tides with any vessels that can be expected to navigate upon the intended canal; which vessels I would
propose

propose to be such as may be able occasionally to go from Port Glasgow or Greenoch to Leith.

From the point of partition of the waters in Dolater-bog to the barns of Clyde, by the course of the canal, the distance is about eighteen miles, English measure; so that the whole length will be about twenty-seven English miles.

I shall omit the description of the passage by the way of Loch Lomond, and only notice the difference of length, rises, falls of water, and expence, which occasioned that I have described to be preferred to the other.

The passage by Loch Lomond measures, by the course of rivers, &c. from Dumbarton, through Loch Lomond to Alloa, near Stirling, by the loops of the rivers, about seventy-three miles; and it further appears, that, by the most direct passage that can be made, it will be at least forty miles; consequently there is a difference of thirteen miles in favour of the first described tract for a canal.

From what has been already observed, it is manifest that the Loch Lomond passage is considerably further about than the Carron passage, and that it is at least equally embarrassed with difficulties; the only point, therefore, in which competition can be supposed, must be on account of expence. In order to bring this matter into a narrow compass, I will suppose the Loch Lomond passage to be executed at the least possible expence; in which case the distance, as before-mentioned, will be seventy-three miles: the impediments being supposed equal, the difference of expence will consist in two articles, viz. the difference of length of the artificial part of the navigation, and the difference of lockage. To reduce the difference of expence arising from the difference of length of the artificial part to the most simple form, I will suppose, in favour of Loch Lomond passage, that the parts of the river to be made

navigable by means of dams, &c. require the same expence as the same length of canal; though in general this kind of work turns out more expensive in such embarrassed situations.

	Miles.
The whole length of the artificial part by the Carron passage, is	27
The whole length of the artificial part in the Loch Lomond passage, is	17
Difference of length in favour of Loch Lomond artificial navigation	10

	Feet.
The perpendicular height of the summit of the Bog of Bollat, above the neap-tide, high water, surface of the Clyde at Dumbarton, by the Loch Lomond passage, is	222

The height of the summit of Dolater Bog, above high water at Carron shore, by the Carron passage, is	147
--	-----

Difference of perpendicular height, in favour of the Carron passage	75
---	----

But this difference of perpendicular height, in point of lockage, will be double	2
--	---

	Feet
	150

The lockage I estimate at 100 l. per foot, rise or fall: the difference being 150 feet, comes to	£.
	15,000

I estimate the cutting at 1,250 l. per mile, inclusive of extra banking, bridges, tunnels, towing-paths, and contingent works; therefore ten miles on the Loch Lomond passage extra, will come to	12,500
---	--------

The difference of expence in favour of Carron	2,500
---	-------

So

So that the Loch Lomond passage will cost 2,500 l. more than the Carron passage, is further about by almost forty miles, and will be attended with an additional loss of time in passing, and expence in keeping between thirty and forty locks in repair.

To give any further particulars relating to the Carron passage, and method of supplying the canal with a sufficient quantity of water for the purpose of navigation, would be tedious, and, I think, unnecessary; I shall therefore proceed, without mentioning the burns and haughs they had to pass, to the number of locks, their situations, and general expences, which are as follows:

	No. of Locks.
From Carron shore to the intended level of a canal above Camelon I make to be 108 feet, which, at 4 feet each, requires	27
From thence to Castle Carey-bridge, the canal being upon a level, will require none; but from Castle Carey-bridge to Redburn there is a rise of 16 feet, which, at 4 feet each, will take	4
From Redburn into the canal of partition, being 21 feet, at three feet each, will require	7
Number of locks from Carron shore to the point of partition	38
From the canal of partition to Inchbelly-bridge, the fall I estimate at 36 feet; this, at 3 feet each, will take	12
From thence to the Clyde there will remain 109 feet; which, at four feet each, will take	27
Number of locks from the point of partition to the Clyde	39
Number of locks in the whole	77

N. B. The above is the greatest number that can be required; for if in completing the work it should appear that the supply of water should turn out more liberal, or a less number of vessels be expected to navi-

gate than I have supposed, then some expence may be saved, by making the rise at the locks greater in general, and without preserving a strict equality; by which means they might be made more readily to suit the ground. It must, however, be observed, that the highest lock determines the quantity of water to be used; for were there but one lock of eight feet in the whole number, this would occasion as great a consumption of water as if they were all of the same height, unless an extra supply could be brought to this lock to place against the extra quantity.

Wherever the canal is, by banking, held above soil, that is, above the natural surface of the adjacent land, it is proposed to cut back-drains behind such banks, to receive any leakage that otherwise might hurt the adjacent soil, and to conduct the same to some common water-course; also to lay tunnels under the bottom of the cut, to communicate with such water-courses across the same as require to be preserved, or whose elevations may not suit to be brought into the canal: also to make bridges in proper places over the canal, for communication between such properties as shall be severed from the same; and to make gates upon the towing-paths between every fence, and double-gates, if required, for the divisions between different properties, with over-falls in proper places for discharging the surplus water, and whatever else may appear necessary for preserving the possession of each person's property, as near as may be, in the same state as it shall be before the execution of this project.

The breadth of the canal is proposed to be twenty-four feet in the bottom, and the sides to be sloped, at a medium, in the proportion of five to three; that is, to every three feet deep, to widen five feet on each side, or ten feet on both sides; to have five feet depth of water, and to be, at a medium, seven feet deep within soil, so that its mean width at the surface of the water will be forty feet eight inches; and to be made wider at convenient places, at proper distances, for vessels to pass each other.

It

It is intended to make the canal less; for boats of seventeen feet and a half wide, drawing four feet water, would make them draw hard, and to make it larger would induce an unnecessary expence. The locks I would propose not to exceed four feet rise each, in order to save water in the working them; as if made with lesser rises they would be too troublesome, on account of the number; only between Redburn and Inchbelly-bridge, as water may be there more scarce, I have proposed they should there have them of three feet rise each.

I come now to consider the expence of making the canal.

The canal being 24 feet mean width in the bottom, and 7 feet mean depth, with slopes as 5 to 3, the width at top will be 48 feet, and the mean width being 36 feet, will contain 28 cubic yards in each yard running, and in a mile 49,280 cube yards digging, which, at three-pence per yard, comes to 616 l. per mile, and for 27 miles in length, to ——— 16,632

Extra digging in the canal of partition, to make it 50 feet at bottom, 53,308 yards, at three-pence per yard, will come to ——— 667

Extra work in making passing-places, and some additional measure by turning the angles, we may allow upon the whole the value of one mile ——— 616

The canal being 48 feet at top, allow the same width for the banks on each side, that is 48 yards in breadth over, all which makes in one mile 84,480 square yards, which is 15½ Scotch acres nearly; and for 27 miles 418½ acres, which, supposing them to be purchased, at a medium, at 20 l. per acre, come to ——— 8,370

Besides what is immediately occupied by the canal and its banks, lands will be wanted for conveniencies, trenches, reservoirs, &c. which in the whole may amount to 20 acres ——— 400

Carried forward 26,685

	£.
Brought forward	26,685
The locks, being 77 in number, at 400 l. each, will come to	30,800
To extra-digging in passing a narrow gripe between two rising grounds, a little to the south-westward of Mungul's house ————	100
To extra-digging through the summit of the ground between Glenforn and Newhall, above Camelon ————	100
To extra-banking across six haughs, or hollows, between that place and Bonnie-mill, at an average 100 l. each —	600
To an aqueduct-bridge in passing Bonnie-mill burn, and extra-banking up to the same, with an over-fall for discharging the surplus water of the canal ————	1,000
To extra-work in passing Seabeg's-wood, Trannock-burn, Acre-burn, and some other haughs and risings from thence to Castle Cary-bridge ————	400
To an aqueduct-bridge for passing the river Bonnie, near Castle Cary-bridge, and extra-embanking there ————	800
To a shuttle for taking in water, as occasion may require, from Redburn, and an over-fall for discharging surplus water,	20
To two miles of trenching, in bringing Kilfyth-burn, together with Shien-burn, into the canal of partition, which at one shilling per yard comes to 176 l. and, allowing 74 l. for extra-cutting, with such small tunnels and bridges as may be wanted under and over the same, together with a shuttle and over-fall for taking in the water, and discharging the superfluous water, will come to ————	250
To building a dam or wier across the Kelvin, below Inchbelly-bridge, with proper shuttles for drawing off the water	500
To building such another dam below Calder-bridge	500
To an aqueduct-bridge for crossing the river Allander, and extra-embanking there ————	300
To extra-work in piercing and vaulting a passage through	
Carried forward	62,055

INLAND NAVIGATION.

287

	£.
Brought forward	62,055
the high ground between Canny's-burn and St. German's-loch	1,200
To extra-work in passing Grascaddon	100
To extra-work in making a jetty for defending the mouth of the canal, and clearing the passage into the Clyde	150
To five public road-bridges, viz. at the road from Falkirk to Carron, at Camelon, at Castle Cary, at Canny's-burn, and at Yocker, at 100 l. each	500
To twenty-one bridges, where the lesser roads intersect the canal, at 75 l. each	1,575
To twenty-eight private bridges, that may be wanted for preserving communications between the lands, making, with the public road-bridges at an average, two in a mile, at 50 l. each	1,400
To thirteen large tunnels, for communicating the lesser brooks under the canal, at 40 l. each	520
To sixty-eight small tunnels, for preserving water-courses, making together, with the large ones, at an average three in mile, at 10 l. each	680
To making towing-paths, back-drains, gates, towing-bridges, &c. at 20 l. a mile	540
To bringing the water of Enrick, from a little above Randedford, into Carron	150
To bringing the burn of Ballagin, with some springs rising out of the hills to the west of the spout of Ballagin, into Kelvin	100
To temporary damages to lands and mills, unforeseen accidents, impediments, and works, engines, utensils, and super-vival	10,000
Total	78,970
	In

In order to estimate the amount of the tonnage, by which the expence is to be reimbursed, I examined the gaboats which ply upon the Clyde, and are capable of navigating that frith in all common seasons, and which I apprehend, by the same rule, would navigate the frith of Forth between the canal and the port of Leith, if required. I found that a middling gaboat, of 56 feet long between stem and stern, $17\frac{1}{2}$ wide, and drawing four feet water, will carry at least 40 tons; and this I look upon to be the largest size that will be convenient for an artificial navigation. Now suppose twenty of these boats pass in a day at an average, in the driest seasons, that is ten each way, and supposing them to go full loaded from the Clyde to the Forth, and half loaded from the Forth to the Clyde, they will carry 600 tons of goods per day, and 4,200 tons per week, in which I reckon seven days; for though the boats should not work on Sundays, yet as the water will be amassing, the capacity of carriage, in point of water, will not be diminished; which will also be the case though they do not go regularly. But casting off the 200 tons for accidents and disappointments, and reckoning 4,000 tons per week, the total will amount to 208,000 tons per year, exclusive of what may further be done when the supply of water is unlimited. The lock-duty, exclusive of freight, would, I apprehend, very well bear five shillings per ton; but at two shillings and six-pence, 208,000 tons would amount to 26,000 l. per annum. From hence I would infer, that if we could furnish water in dry seasons for twenty boats per day, there will be water enough, at the lowest tonnage that can be supposed, to raise a much greater annual sum than can be wanting for repairs, and to discharge the interest of the capital to be expended, and, in all probability, more water than the trade can possibly want. But I would not have it inferred from hence, that, because the canal can carry 208,000 tons per year, there will be 208,000 tons per year to carry: the price of tonnage therefore must be fixed according to the probability of carriage, which I leave to the decision of those who are better skilled both in the general trade of this kingdom, and the particular trade of these parts, than I am.

On

On further considering the subject of the foregoing report, Mr. Smeaton is of opinion it will be eligible to carry Redburn into the canal of partition, not as a subsidiary expedient in case of need, but to be applied in the first construction, the charge of which will be amply recompensed by the omission of five locks between Redburn and Inchbelly-bridge; for the three-feet locks proposed in that district may then be four feet, the same as all the rest: and it will appear, by what has been said before, that the water expended on the whole will be precisely the same; so that then the number of locks will be thirty-six each way, and in the whole seventy-two.

Mr. Smeaton has contrasted the canal of Languedoc with that of the rivers Forth and Clyde, in the following manner:

As the noblest work of the kind that ever has been executed, I mean the royal canal of Languedoc, has been generally esteemed not to answer the expence, this will undoubtedly be made an argument against the present proposition; I shall therefore oppose some matters of fact relating to the French canal, by way of parallel.

CANAL of LANGUEDOC..

Length of the canal between Port de Cette, on the Mediterranean, and Thoulouse is 152 English miles, besides a river-navigation from Thoulouse to Bourdeaux, which is above 100 miles more; so that the whole length of inland navigation is above 250 English miles between the sea-ports.

CANAL of FORTH and CLYDE.

Length of the canal between Carron-shore and the Barns of Clyde is 27 English miles. Sea-vessels go up to the Carron-shore and to Dumbarton, the distance of which, by the canal, will be 33 miles; but reckoning from Port Glasgow to Leith, the distance will not exceed 70 English miles.

P p

Suppose

Suppose the vessels make way, at an average, $1\frac{1}{2}$ mile per hour, the passage will take fourteen days, of twelve hours each.

The perpendicular height of the point of partition is 639 feet English above the two seas.

This canal is navigated by one hundred locks, of above 8 feet rise each.

The expence of this undertaking has been 612,500 l. sterling.

This work is still incomplete, by reason of the shoals in the river Garonne, below Thoulouse, which in dry seasons greatly interrupt the vessels; to carry the canal below which, as the only remedy, it is estimated will cost 43,750 l.

Suppose the vessels to make way, at an average, $1\frac{1}{2}$ mile per hour, the passage will be but four days, of twelve hours each.

The perpendicular height of the point of partition in the proposed canal is 145 feet.

This canal is to be navigated by seventy-seven locks, of between 3 and 4 feet rise each.

The expence of this undertaking is estimated at 78,970 l. sterling.

This canal falls into the rivers Carron and Clyde, in the tideway, at places where there will be no obstruction to the vessels proposed to navigate the canal in the driest seasons at high-water, and whence they may proceed on their voyage to their respective seaports.

Now if it may be admitted that as great a trade is likely to be carried on between the Forth and Clyde, where the sea-navigation is long and dangerous, and the inland short and easy, as between the Gulf of Lyons and the Bay of Biscay, where the sea-navigation is open at all times, though long, and the inland navigation tedious, and sometimes

almost

almost impassable for want of water over the shoals in the river; the inference is plain, viz. that the same tolls which will hardly keep the French canal in repair, will make this a very beneficial undertaking to the British adventurers.

In the former part of this work I mentioned a writer who was an advocate for a river-navigation between the rivers Forth and Clyde, notwithstanding every argument from theory, and proof from practice, of its disadvantages; and as I there promised to give some account of what has been said in its favour, I cannot do it in a more proper place than here, as the publication in question particularly relates to the navigation betwixt the Forth and the Clyde, and frequently mentions Mr. Smeaton's report, from which several extracts have just been given. As the pamphlet is a work of considerable merit and acute reasoning, I presume I shall be excused for departing from my first resolution, which was not to take any notice of river-navigation.

This pamphlet is intitled, "Reflections on Inland Navigations, and a new Method proposed for executing the intended Navigation betwixt the Forth and the Clyde in a complete Manner, and at an Expence one-third less than what that Work has hitherto been estimated at." It is addressed to the noblemen and gentlemen subscribers for forming a navigable canal to join the Forth and Clyde, at whose desire it was composed by J. Gray, 1768.

"It must give," says this writer, "a singular pleasure to every well-wisher to Great-Britain, to see so much attention at present bestowed upon the forming of navigable canals in different parts of this island, particularly in regard to that for opening a communication for sea-vessels between the Forth and the Clyde, which, though not the most difficult in point of execution, is by far the most national and most important. This, as it is now proposed to be executed by the subscribers, will not partially regard a single town, or extend its influence to one or two

counties only, but will be a thoroughfare for the east and west coasts of the whole island, nay even for different nations, for it will in a manner bring Ireland and America on the one hand, and Germany and the nations of the Baltic on the other, reciprocally three hundred miles nearer each other. Foreigners will therefore doubtless be surprised to find this an attempt of private undertakers, when the very nature of it renders it a national object of the first importance. Such, I make no doubt, it will appear to our legislature; and that, if private funds should fail, or prove insufficient, we may expect to see it carried on and completed at the public expence with the general approbation. What therefore, I think, ought chiefly to be attended to at present, is the manner of doing it well, and to the best advantage, without a strict limitation as to the expence. But though no certain sum should be fixed upon for the finishing the undertaking, it is nevertheless extremely proper to examine how the least expence may be incurred in executing the work in the completest manner.

“ Mr. Smeaton has, with much solidity and discernment, given a distinct and accurate detail of the requisites for completing a navigation, upon the supposition of digging an artificial canal from sea to sea; and if that plan should be adopted, I am persuaded that the real expence would be found to differ extremely little from his estimate. I propose, however, to offer another method, which appears to me much more natural, much more simple, to be founded on the plainest principles of hydrostatics, and which would answer every purpose of the subscribers, in affording an easy and safe navigation of sea-vessels from frith to frith, though it would cost considerably less than the plan hitherto proposed.

“ When water is confined on every side, it naturally places itself upon a level, but if any one part of the confining bank be made lower than the surface, the water will immediately descend by that breach till it meets with some other obstacle; for its gravitation makes it always seek to approach

proach the centre of the earth, and its fluidity gives it an easy opportunity of escaping ; for a declivity in one part affects the whole surface. Let us suppose a quantity of water, of an equal depth, contained in an oblong vessel, with two sides and two ends, the sides and ends will have an equal pressure upon them ; and were the length and breadth to be augmented never so much, yet, if the depth be not augmented, the pressure upon the sides and ends is no more in the greater surface than in the smaller ; for it is an established principle, that water does not press against its banks according to its surface, but according to its perpendicular height or depth. A canal or river made navigable by art, is nothing else between lock and lock than this oblong vessel ; and the same banks that will contain a small mill-stream ten feet broad, will suffice to contain a canal a hundred feet broad, if the depth in both be equal : and should an overflowing happen, it is altogether indifferent whether the superabundance of water escape by the sides or by the end ; nay, by the construction which I shall propose, its escaping by the end is attended with particular advantages. I think, therefore, that in numberless cases it may be deemed labour thrown away to carry canals along the sides of rivers at a great expence of digging, extra-banking, aqueduct-bridges, tunnels, sluices, &c. when often at a less expence, and to a much better effect, the rivers themselves might be made navigable, without the least cause of apprehension of any excess of water ; as in the very construction of the canal the danger of an overflowing may be provided against. The great rapidity and violence of rivers, during a flood, has no doubt been the reason that deterred the constructors of canals from risking any communication with them. But though a body of water running down a declivity be a furious giant, overturning every thing before him ; yet if this said giant be laid flat upon his back, he loses all his force, and becomes entirely passive, whatever be his size. If they had reflected on this principle, they might have easily seen that they had it in their power, by banks and dams of a particular construction, to bring almost every river, requiring art to render it navigable, to this passive state ; I say almost every river, because direct cataracts

taracts and perpendicular waterfalls must be excepted. Some other rivers also, consisting of a large body of water running down a steep descent, ought to be neglected; because it could hardly be expected that the profit arising from the navigation could repay the expence of making it.

“ But that is far from being the case of the two small rivulets that have their course in the tract of the intended navigation. They are both very inconsiderable, are almost dry in summer, and run very gently into the different seas, excepting in one place, where one has a cataract, which may be easily avoided. The reader who has not an opportunity of viewing the tract upon the spot, may imagine to himself a narrow valley, running transversely for thirty miles from sea to sea, and bounded on the south and north by high and mountainous ground. The middle of this valley is almost a dead level for ten miles, and two small brooks that rise there form a straight line, by running in opposite directions into different seas. The current of those brooks is extremely gentle; for the place where they take their rise has been found by measurement not to exceed a hundred and forty-seven feet above the level of the sea.

“ From this account it plainly appears that the question ought not to be about digging an artificial canal, but about banking in two small brooks. So far from being afraid of those two rivulets, I actually consider them as nothing, but regard their channel as the most proper bed and declivity for the canal; a declivity pointed out by nature, which may easily be reduced to so many levels by dams and locks, and which may be banked on both sides, at what breadth we please, without having any extra-digging or extra-banking in their whole course, but, on the contrary, offering us great part of the work already done to our hands. These rivulets, in their course, keep always in the lowermost part of the valley; and, in carrying a canal through this valley, is it not most natural to take the hollowest part for the course of the canal, rather than carry it over waving and uneven ground, which by being too high in some parts

parts occasions extraordinary digging, and, by being too low in others, requires extraordinary banking? By choosing the course of the rivulets for the tract of the canal, fluices, tunnels, and aqueduct-bridges are also all superseded and rendered unnecessary; for, instead of turning aside little rivulets or occasional streams, the canal would be the common receptacle of all of them, as it would be so situated as to receive them all, and by its construction could never be incommoded by them. The following this tract would likewise be attended with other advantages; particularly, there would be no new division and separation of private property, and there would be very little occasion for any change of property whatever, excepting the property of the rivers and their banks; for though the rivulets are inconsiderable, yet in many places there is as much land on both sides of them wasted, as would suffice for ground for the canal, were it even to be a hundred feet broad; and surely that waste ground cannot be highly valued by the present proprietors. By placing the canal in the hollow, it would also be easier to improve the ground on both sides of it, which will no doubt soon change its face after the navigation is finished, and become three or four times more valuable than it is at present. But what is the most material is, that this tract seems by nature most fitted for the course of the canal.

“ As the two rivulets that run through this valley are inconsiderable in proportion to the intended size of the canal, and, as shall be afterwards shewn, can never be dangerous even in floods, I would propose that the hollow of the valley where they run should be fixed upon for the course of the navigation; and I would form the canal, not by digging for the whole depth, but by two parallel mounds or banks, placed eighty feet asunder the whole way, even at the locks, like two parallel turnpike-roads, and raised so high that the banking and digging put together should include a depth of twelve feet. In forming the canal, by banking along the course of the rivulets, we should have, as I said above, great part of the work already done to our hands; for the rivulets in many places have formed a considerable channel, which they rarely occupy;

cupy ; in others their ordinary surface is one, two, or more feet below the banks ; and in others, the ground close by the river naturally forms a considerable mound, so that the water might there be kept up twelve feet deep by one artificial mound only. All these natural advantages are so considerable, that I am persuaded they would render the expence of forming the banks one-third less than it would otherwise be.

“ Let us consider the canal awhile as extending from sea to sea without locks, and the two banks sloping in the proportion of five to three ; it affords us a capacious bed twelve feet deep, forty-eight feet broad at bottom, and eighty feet broad at top. This gives us a medium breadth of sixty-four feet, which multiplied by twelve feet, the greatest depth, gives us seven hundred and sixty-eight feet for the contents of the canal. Let us now compare this with the two rivulets, both in their common state and in their greatest augmented state, and we shall find that, even in the last, they would be entirely absorbed in the canal, and would never overtop its banks. In the end of November last (1767), when there was a great deal of water on the ground almost every where, I viewed the Bonie water and the Kelvin, which were each of them in an augmented state, and, as I was assured, near double their ordinary size ; yet even then the Bonie water, near Bonie-bridge, was only about ten feet wide and one foot deep ; and the Kelvin, at Inchbelly-bridge, was about fifteen feet broad, and a foot and half deep ; which gives for the medium quantity of water little more than sixteen feet, when the rivers were double their ordinary size. The quantity then flowing in their ordinary state is only about eight feet, which is not the hundred and fiftieth part of what might flow in a canal of the dimensions above-mentioned, upon the supposition of its being brimful, and the current meeting with no stop or obstruction from sea to sea. It may however be said, that though the rivers Bonie and Kelvin be really very inconsiderable in dry weather, yet there is seldom a winter passes that they are not swoln with land-floods, which raise them above their banks, and overflow the country for several hundred yards on both sides.

fides. But let these floods be narrowly examined into, and the greatest excess of them computed, by consulting the oldest persons living in the neighbourhood, and I am persuaded it will be found that they never have risen to such a degree as that they could not be contained with ease in the channel of the proposed canal.

“ There was this autumn a great flood in the Kelvin, which overflowed the vale in many parts, for a length of five or six miles, and carried off considerable quantities of corn, that was standing in sheaves upon the field ; and so great a flood, I believe, has not happened for very many years past ; yet I have been assured that, by marks upon some trees and shrubs near Inchbelly-bridge, it appeared this great flood had not risen more than six feet above the usual level of the river. Its spreading wide over the vale, was only a proof of the levelness of the vale, and was owing to its not being confined ; for, exclusive of perhaps thirty or forty feet in the middle, where lay the thread of the stream, all that great breadth was dead water, which, if the river had been hindered from extending itself, would have been carried off, in proportion as the flood rose, by the increased velocity of the stream, without augmenting its extraordinary depth perhaps above six inches. This great flood, then, when narrowly examined, and supposed to be confined all the way between two hills forty feet asunder, would probably have turned out to be a stream not seven feet deep. But the capacity of the canal I have proposed, which is twelve by sixty-four, is large enough to let a stream four times as great as that pass easily through it, as is well known to those who are acquainted with the motion of fluids, which increases as the depth increases ; consequently, supposing a flood twice or thrice as great as the late great flood, the canal and the navigation would have nothing to fear from it.

“ I enquired the height of the greatest floods in the river Bonie, within two miles of the sea, where it loses its name on account of its junction

Q q

with

with the more considerable river, the Carron ; and I was shewn by one of the overseers of the works at Carron the marks of the greatest flood in his remembrance, which are about six feet above the usual surface, where the breadth was about sixty feet. But supposing the Bonie water (or the Carron) at that time flowed nine feet deep, and sixty feet broad, the canal I propose could well afford room for a flood twice as great as that. There does not therefore seem the least grounds to think that a canal of the dimensions above specified would ever be endangered or incommoded by any flood, on the supposition of the waters having a free course through it. But should it be found that the floods are larger than I have computed them (though the canal would allow room for floods twice as large as those I have mentioned), it is only setting the banks a hundred feet asunder instead of eighty feet, and the danger is provided against ; and the canal becomes more magnificent without any great additional expence, as shall be treated of more particularly afterwards.

“ As to the banks or mounds, it will be proper not to be sparing of the expence in their first construction, but to make them sufficiently strong, that is to say, sufficiently thick, that they may almost appear like the work of nature, and never after need any repairs. I would advise that they should be raised at an average eight feet above the surface of the ground, should be twelve feet broad at top, and slope towards the canal in the proportion of five to three. In the forming of them, the very wideness of the canal gives us particular advantages ; for four feet depth of earth over the whole bottom of the canal, together with what is dug for making the back-drains, will nearly supply earth for the completing of them. What is wanted may be easily carted from different spots in the neighbourhood, as is done in the making of turnpike-roads ; but it will never be necessary to bring it from any great distance, like the materials for roads, because proper earth may be found almost every where : consequently the expence of making those mounds may be pretty nearly estimated, from what has been paid for making the turnpike-road to Kilsyth per mile, as I reckon that both the banks together would amount
to

to about six times as much, deducting, however, one-third for what is already done by nature.

“ Were the mounds to be constructed of the size and form above-mentioned, I am persuaded hardly any one would doubt of their being sufficient for the purpose intended by them, of confining the two rivers, and all the water that should come from the point of partition or head source, with the other occasional streams that might fall into the channel in the course of the canal. But to convince the most incredulous, I shall give an instance of a river above a thousand feet broad, navigable even for vessels of war, which is confined by artificial mounds, and whose surface is above ten feet higher than the adjoining ground on both sides.

“ That river is the Thames, which in different places below London, particularly from the Isle of Dogs to the Woolwich-marshes, is fenced in on both sides by artificial mounds, though it be there above fifteen hundred feet broad, and the tide, during six hours of the four-and-twenty, be full ten feet above the surface of the adjoining ground.

“ History, I believe, does not mention when these mounds were first made ; but probably without them there would be two hours less tide at London, and the navigation up and down would be more dangerous, as vessels might frequently be stranded on the shallow meadows : thus, though the Thames may justly be reckoned one of the first navigable rivers in Europe, it is nevertheless indebted in some degree for its navigation to art.

“ What has been done at the Thames is an example before our eyes of the easy practicability of what I propose for the present navigation. But besides the Thames, there are numbers of other rivers, and artificial canals carried above soil, without any inconvenience from soakage or leakage, or any danger to the banks themselves, which by their own weight, and the moisture of the river, soon consolidate into one mass.

How many mill-streams might be particularised that are banked on one side? The river St. John, in Nova Scotia, is banked on both sides, like the Thames, for a great number of miles. The New River is conducted to London in many places above soil. The duke of Bridgewater's canal is not only supported in many places by an artificial bank, but the bottom of the canal itself is mounted above the natural surface between thirty and forty feet, and is carried over an artificial mound of earth of that height for several miles together. To conclude, the canal proposed by Mr. Smeaton in both his reports, is intended to be banked in several places, particularly in a hollow, west from Camelon, eighteen feet deep, and two hundred and ten feet wide at top, where the very bottom of the canal for a considerable way will run about eight feet above the natural surface.

"I have hitherto considered the canal as without locks; but having explained the form and size of the mounds or banks, and given, I think, incontestable proofs that they would effectually answer all the purposes expected from them, of keeping up the water on the sides without leakage, I shall now proceed to a particular description of the lock that is intended to keep it up at the end, or transversely.

"I propose that the breadth of the canal should be divided into three spaces, by two stone piers of ashlar work, ten feet thick and eighty feet long, built parallel to each other, at the distance of twenty or twenty-four feet, like the piers of a bridge. The space between these two piers forms the lock, by being built up at the upper end six feet high, and having flood-gates at both ends. I propose the fall of the lock to be only six feet, because that added to the depth of water, which may be eleven or twelve feet, will require the lower gates to be eighteen feet high, which is a size sufficiently large for the convenience of working; and the tops of the piers may be built flat, with a small parapet and a capstan (campshot is meant) at each end, for the men to walk upon them to work those gates. If the breadth of the lock be twenty-four feet, the

two outward spaces, from the piers to the banks on each side, will be eighteen feet wide each; and it is proposed to shut up those places by flood-gates, twelve or thirteen feet high, made to open occasionally, and likewise to have sliding-vanes or sluices. Supposing the flood-gates of all the three spaces shut, and that there is no want of water at the point of partition or upper source, where the chief of the supplies will be collected, it is plain that the canal will quickly be filled to the top of those gates and the top of the banks; and, if the water continues to run, it will soon flow over them: but to prevent that, the sluices of the gates, or the gates themselves may, by those who reside at the locks, be easily kept open, in the proportion necessary to give a free passage to all the superabundant water, without diminishing in the least the quantity once collected in the canal; by which means, what the poet metaphorically says of the Thames would be literally true in regard to the canal; *Tho' never overflowing, it would be always full.*

“ Let us examine the supplies of water at the point of partition, or head reservoir, to see if we can draw any more use from them than that of filling the canal, and furnishing water for the navigation. On the supposition that the extent of the navigation on the canal will require annually, as by Mr. Smeaton's second report, $5,333\frac{1}{3}$ locks full of water, that by the lock I have proposed will amount to 61,439,616 cubic feet per year, or 168,328 cubic feet per day. As the canal of eighty feet broad has three flood-gates at each lock instead of one, I shall suppose that the leakage per day is three times as much as it is stated by Mr. Smeaton, or twelve locks full, which is 138,240 cubic feet. Reckoning the exhalations in the same proportion as Mr. Smeaton, or at one-tenth of an inch per day (though that be a large allowance), the daily expence in that article in a canal thirty-seven miles long, and seventy-five feet broad at the water-line, will be 122,100 cubic feet. As the banks I propose may justly be reckoned as tight as the natural earth, the soakage cannot be supposed more here than in the other canal, unless

less upon account of the augmented depth ; we shall therefore state it at 110,000 cubic feet per day, and the total expence of water per day will stand thus :

	Cubic Feet.
Water expended by lockage per day	168,328
leakage per day	138,240
exhalations -	122,100
foakage -	110,000
Total of water expended per day	538,668

“ To supply this daily consumption, there are six small streams or burns that may be made to run and empty themselves in the head reservoir at the bog of Dolater ; from whence the canal may be amply furnished with water to both extremities. These burns or streams are computed by Mr. Smeaton to furnish, during seven months of the year, 1,842,043 cubic feet per day ; for three other months to supply 669,678 cubic feet per day, and in great droughts, during two months, to yield only 254,328 cubic feet per day ; consequently though for near two-thirds of the year there would be a great deal more water than is wanted for the navigation, yet during two months it would seem that there should be a considerable deficiency.

“ But that all deficiencies may most certainly and amply be supplied, so as at all times to afford a great redundancy of water, if desired, will appear most plainly from the following further remarks of Mr. Smeaton : The bog of Dolater, he says, to the extent of 200 English acres, may by dams at each end be laid six feet under water, and deducting one foot depth for exhalations, there would still remain 43,560,000 cubic feet of water, which would supply the deficiency occasioned by the drought for 158 days, or five months. Besides, at Townhead lint-mill, about a mile north of the point of partition, and considerably above the level of that,

that, a valley or hollow may, by a dam not fifty yards long, be laid under water four or five fathoms deep, so as to form a reservoir equal in capacity to that of Dolater. On the south side of the canal the waters of Bishop's-loch, and of four others in the neighbourhood, forming altogether a surface of between three and four hundred acres, may be pent up from four to six feet higher than at present, and brought to Dolater-bog. Besides these three reservoirs, each of which may contain about 43,000,000 of cubic feet of water, he mentions several other rivulets that might be brought to account. He concludes, "That were ten times as much
" water necessary for the canal as what appears to be so, there is the
" evident means of bringing it, and amassing it without putting any
" strain upon nature.

" Since then it is so easy and practicable to have an ample supply of water at the point of partition, I would propose that provision should be made not only for the daily consumption before-mentioned of 538,668 cubic feet of water, but also for as much more as should be sufficient for turning a mill at the first lock, at each end at the point of partition or head reservoir. The fall of the lock will serve for the fall of the mill; and supposing a mill at every other lock on each hand all the way downwards, the same water that turned the uppermost mills would serve to turn all the rest; so that if there be fifty locks upon the canal, there may likewise be constructed fifty water-mills, if wanted, without any prejudice to the navigation. The millers of those mills would be the natural keepers of the locks; and as they would always be upon the spot, every land-flood could easily be regulated by them, so as to be imperceptible in the canal. Some great floods indeed must be excepted; but such as these do not happen every winter, and when they do happen, seldom continue above six or seven days; during which time the navigation of the canal would be rendered more difficult. This week's loss, however, may be set against the same time that would probably be lost every winter in the artificial canal by frost, and the account stand balanced; for, in frosty winters, it may well be presumed that dead water
would

would be incommoded with ice for more than a week longer than water that has a small current, and which might be made to raise and lower its surface some inches every two or three hours.

“ When we consider likewise, that the greatest floods generally happen in the end of autumn, when the head reservoirs are at the lowest ebb, the rain that descends, and the augmented rivulets might be in a great measure kept collected in those reservoirs, and let gradually into the canal; by which means the impetuosity of any flood might be greatly abated. But supposing the head reservoirs full, even in that case, were all the flood-gates of the canal thrown open, there would, as has been shewn, be room enough for the greatest probable flood to pass off, without ever getting out of the bed of the canal; for, from one dam it would flow to a second, and from that to a third, &c. always finding a channel more capacious than was required.

“ The locks and dams which I propose, consisting of two piers and three flood-gates, besides rendering the navigation of the rivulets practicable and easy, and giving the profit of the mills, might also serve as bridges, by laying beams from one pier to the other, and from each pier to the adjoining bank; but it must be remembered, that the part between the two middle piers must be made a draw-bridge, to be lifted up at the passing of each vessel. It is proposed in general, that every dam should serve the triple purpose of being a bridge, of lifting the water for the use of the navigation, and of containing it for the use of the millers.”

The above extracts appear sufficient to explain the plan, and state the principal arguments of this writer; those who wish for a more full account, may consult the pamphlet itself*. I shall however subjoin, from the same publication, an estimate of the probable expence of completing the canal according to the plan there proposed.

* Printed for T. Cadell, in the Strand, 1768.

“ The length of the canal will be about 37 miles from the mouth of the Carron to below Dunbuck-ford, on the river Clyde, with a side-branch to Glasgow, as in the charts already printed ; and its breadth, from the outside of one back-drain to the outside of another, 129 feet, or 43 yards, consequently it will occupy in the whole 452 Scotch acres ; but it must be remembered, that great part of this tract is waste ground on both sides of the rivulets, and, instead of being of any profit to the owners, often brings damage to them ; consequently the parting with it would render what remains of more value to them.

The real ground to be valued for the canal would therefore	£.
probably not exceed 300 acres, which, at 20 l. per acre, is	6,000

Supposing 100 acres more allowed for reservoirs, that, at	
20 l. per acre, comes to	2,000

In the length of the canal there will be about four miles	
required to be dug wholly within foil ; namely, two miles at	
the point of partition, and one mile at each end next the sea ;	
this makes about 600,737 cubic yards of digging, which, at	
three-pence per cubic yard, is	7,509

I propose the banks, at an average, eight feet above foil, twelve feet broad at top, and sloping toward the canal in the proportion of five to three, which will give, for a medium thickness, $18\frac{1}{2}$ feet ; both the banks together being reckoned 68 miles long, the cubic yards contained in them will amount to 1,968,071, which, at three-pence per cubic yard, is 24,600 l. But of this sum, as I have before observed, one-third ought to be deducted for what is already done by nature, consequently there will remain for the expence of banking

— — — —	16,400
---------	--------

To fifty locks, at 1000 l. each	50,000
---------------------------------	--------

Two abutments on the banks at each lock, in all a hundred	10,000
---	--------

For the dams at the ends of the bog of Dolater, as by Mr. Smeaton's estimate	2,277
--	-------

94,186

To

R r

	£.
Brought forward	94,186
To extra expences on the Alander passage, by same estimate — — — —	13,754
To extra expences in carrying the canal to Glasgow over the river Kelvin, by Mr. Smeaton's estimate —	5,333
For conducting streams to the reservoir, by same estimate	500
For 100 small bridges of one arch, 10 feet space each	3,000
For building 80 mills — — —	5,000
For advancing the canal from Dalmuir Burnfoot to below Dunbuck-ford, as by Mr. Smeaton's estimate —	18,000
For unforeseen accidents — — —	20,000
	£. 159,773

“ I have already mentioned, that were the canal to be 100 feet broad, instead of 80 feet, the additional expence would not be very considerable, provided the method of banking be pursued; for it is plain the same banks that would contain the water in a canal 80 feet broad, would also contain the water in a canal 100 or 300 feet broad, consequently the additional charge would be chiefly upon the purchase of the land, and the construction of the locks; the canal of 100 feet broad exceeding the former by 20 feet, would consequently occupy in a length of thirty-seven miles 71 acres more than the other, which at 20 l. an acre would be 1,420 l. The locks and dams in this canal might be built with four piers instead of two, which would probably enhance the expence about 20,000 l. and supposing the two middle piers to stand as before, at 24 feet distance, the two outward piers may be placed so as to leave two spaces, 16 feet broad each, betwixt them and the middle piers; one of which spaces may be formed into a small lock for small vessels. Allowing 20,000 l. more extra expences, the whole additional charge incurred in forming the canal 100 feet broad by banking, would be 41,420 l.

“ By pursuing the method of banking, I venture to aver that a canal 15 feet deep, and 300 feet broad, excepting at the locks, might here be made from sea to sea for the expence of Mr. Smeaton's highest estimate, or 293,444 l. which he computes a canal will cost 69 feet broad and 12 feet deep, dug all under soil. Every reader may recollect what great quantities he has seen collected in gather-dams, or mill-ponds, by banks above their surface; and I appeal to any artist, who shall view this vale, whether it is not very easy to form a string or chain of gather-dams from sea to sea, affording a depth and breadth of water sufficient for the navigation of vessels of one or two hundred tons. Some canals in this island are justly matter of wonder, on account of the curious artifices used in their construction; but I could wish the whole wonder of this canal should be its simplicity, joined to an air of magnificence.”

So far my author, whose merits or demerits I leave to the judgment of the discerning reader; to add my own opinion would be superfluous. I shall therefore proceed, as I have done before, to give a short extract from the act obtained to carry this most useful canal into execution, and conclude with the best account I have been able to procure in what manner it was completed.

This act (1768) is intituled, An Act for making and maintaining a navigable Cut or Canal from the Frith, or River of Forth, at or near the Mouth of the River Carron, in the County of Stirling, to the Frith or River of Clyde, at or near a Place called Dalmuir Burnfoot, in the county of Dumbarton; and also a collateral Cut from the same to the City of Glasgow: and for making a navigable Cut or Canal of Communication from the Port or Harbour of Borrowstouness, to join the said Canal at or near the Place where it will fall into the Frith of Forth.

The preamble sets forth, That whereas the making a navigable cut or canal from the Frith, or river of Forth, at or near the mouth of the river Carron, in the county of Stirling, to the Firth or river of Clyde,

at or near a place called Dalmuir Burnfoot, in the county of Dumbarton, through the counties of Stirling, Lanerk, Renfrew, and Dumbarton, with a collateral cut or canal to the city of Glasgow, will open an easy communication between the firths of Forth and Clyde, as also between the interior parts of the country, which will not only be a great advantage to the trade carried on between the said two firths, but will also tend to the improvement of the adjacent lands, the relief of the poor, and the preservation of the public roads, and moreover be of general utility; be it enacted, &c. &c. Then follow the names of the trustees and proprietors. And the said company of proprietors, their successors and assigns, shall be, and are hereby authorised and impowered, from and after the passing of this act, by themselves, their deputies, agents, officers, workmen, servants, and assigns, to make and complete a cut or canal of seven feet depth of water, navigable and passable for boats, barges, and other vessels, from the firth or river of Forth, at or near the mouth of the river Carron, passing on the north side of the house and offices of Kerse, through or near Bainsford, to or near Bonny-mill, to or near Bankier-mill, in the county of Stirling; to and through Doler-bog, to or near Inchbelly-bridge, to or near Calder-bridge, passing between Killmardinny-hill and Beauclair; to or near St. Germain's-loch, and betwixt Clobey-hill and the hill of Bladardy, to or near three-part mill-dam, and to the firth or river of Clyde, at or near a place called Dalmuir Burnfoot, and the said collateral cut of seven feet depth of water from the said main canal, at or near a place called Bladardy, through or near Partick, across the river Kelvin to the city of Glasgow aforesaid; and to supply the said cut or canal, and collateral cut, whilst the same shall be making, and when made, with water; and also to make provision for replacing the water which shall be taken by them from the rivers Carron and Kelvin for the use of the said intended navigation, from such springs as shall be found in making the said cut or canal and collateral cut; and from any part of the river Enrick, and the sources thereof; and from all rivers, streams, lakes, or locks, within the distance of ten miles from any part of the said main cut or canal, as well as for making provision

vision for replacing the water which shall be taken by them from the rivers of Carron and Kelvin as aforesaid; and also to make such reservoirs, within the distance last-mentioned, as shall be necessary for the purposes of the said intended navigation, for the more conveniently supplying the same with water, &c. Provided always, and be it enacted, that the land or ground to be taken or used for such cut or canal, and collateral cut and towing-paths, and the ditches, drains, and fences, for separating such towing-paths from the adjoining lands, shall not exceed one hundred yards in breadth, except in such places where the said cut or canal, and collateral cut, shall respectively be raised higher, or cut above eight feet deeper than the present surface of the land, and in such places where it shall be judged necessary for boats or other vessels to turn, lie, or pass each other in any of the said respective places: nor shall any land or ground be set out, ascertained, contracted for, and sold, for the purposes of making any navigable cut, trench, or sluice, to convey goods, commodities, or other things to or from the said cut or canal, or collateral cut, without the consent of the owner or owners of the said lands respectively, under his or their hands in writing first had and obtained, &c. Proprietors may raise money among themselves to carry on the work, not to exceed one hundred and fifty thousand pounds sterling, to be divided into shares, not exceeding one hundred pounds, sterling money, to each share; and if that sum is not sufficient, a farther sum may be raised, not exceeding the sum of fifty thousand pounds sterling. Subscribers to have a vote for every five shares, by themselves or proxies; but no proprietor to have more than ten votes, even if possessed of more than one hundred shares. The tolls allowed to be taken are as follow: For tonnage and wharfage for all iron, coal, stones, timber, and other goods, wares, merchandises, and commodities whatsoever, which shall be navigated, carried, and conveyed upon or through the said cut or canal, or collateral cut, such rates and duties shall be taken as the said company of proprietors, their successors and assigns shall think fit, not exceeding the sum of two-pence, sterling money, per mile for every ton as before-mentioned, and so in proportion for any greater or lesser quantity

tity than a ton ; and for the tonnage of all light boats, and other vessels without a lading, or in ballast only, which shall be navigated upon or through the said cut or canal, or collateral cut, the sum of one penny per mile shall be taken for every ton burthen of such boats and vessels respectively ; lime and lime-stone to pay no more than one-fourth, and iron and stone only one-half of the rates, tolls and duties aforementioned ; and paving stones, gravel, and all other materials for making and repairing roads (lime-stone excepted) ; and also dung, soil, marle, and all sorts of manure for the improvement of lands and grounds, shall pass free and exempted from tolls or other duties ; and no more than three-pence, sterling money, per ton shall be taken for wharfage by any person or persons, proprietor or proprietors, land-owner or land-owners, who shall or may at any time hereafter make, erect, or build any wharfs or quays on any part of the said intended cut or canal, or collateral cut, by virtue of this act, unless the goods, wares, or merchandise which shall be laid thereon, shall remain or continue on such wharf or quay for a longer space of time than six days : and whereas the joining and communicating the said canal to the port and harbour of Borrowstouness, upon the frith of Forth, in the county of Linlithgow, will make the said canal greatly more useful and beneficial, by opening a shorter and more certain access thereto from the said port, and will likewise tend to the improvement of the adjacent land, and other good purposes ; the proprietors afterwards named are empowered to make the said canal, by themselves, their deputies, agents, officers, workmen, servants, and assigns, and shall make and complete the same, not more than seven feet deep, navigable for boats, barges, and other vessels, from the harbour of Borrowstouness, in the county of Linlithgow, through the lands or kerse of Kinneil, in the said county, to and across the water of Avon, and through the lands of Bearcrofts, in the east kerse, and continued to the said navigable cut or canal from the Forth to Clyde, at or near where the same is intended to join the river Forth in the county of Stirling. And the said proprietors may raise money among themselves to carry on the work, so that the whole sum does not exceed five thousand pounds

pounds sterling, to be divided into one hundred shares of fifty pounds each; and if that should not be found sufficient, a further sum, not exceeding three thousand pounds sterling more, may be raised and divided into shares of fifty pounds sterling each; and every five shares shall have a vote or proxy; and the toll to be collected on the said canal for tonnage and wharfage, for all iron, coals, stones, timber, and all other goods, wares, and merchandises, and commodities whatsoever, which shall be navigated thereon, at the rate of three half-pence per ton per mile, and so in proportion for any greater or less quantity than a ton; lime, lime-stone, and iron-stone, not to pay more than one-third of the tolls before mentioned; and paving stones, gravel, and all materials for making and repairing of roads (lime-stone excepted); and also dung, marle, and all sorts of manure, to be exempted paying any tolls or duties.

In the year 1784 an act passed for extending, amending, and altering the powers of the former act. After reciting and mentioning further particulars, this act proceeds as follows: Whereas the said company of proprietors, in order to accommodate the trade upon the said navigation, have expended a considerable sum of money in building a basin at the east entrance of the said navigation, where vessels lie to load and unload their cargoes; be it farther enacted, by the authority aforesaid, that from and after passing of this act it shall and may be lawful to and for the said company of proprietors, their successors and assigns, in order to defray the expence of supporting, cleansing, and improving the said basin, to ask, demand, and take a wharfage, not exceeding one penny sterling per ton for all goods landed or put into lighters from, and on all goods loaded into, vessels lying in the said basin; and also the same for goods out of vessels lying on the west side thereof; and a wharfage of two-pence sterling per ton on all foreign vessels; and one penny per ton sterling on all British and Irish vessels, to be paid for vessels lying in the north and south outer basin, for the accommodation of larger ships and vessels which cannot enter the inner basin: and for preventing accidents

cidents by fire in the harbour of Grangemouth, or in any of the harbours or basins belonging to the said company of proprietors, a bell shall be rung morning and evening for the space of ten minutes, and all fires, candles, or lamps at the time of ringing such bell shall be extinguished, under a penalty of forfeiting for every offence the sum of three pounds, sterling money; nor shall any pitch, tar, resin, turpentine, or other combustible matter be heated on board any ship or vessel in the harbour or basin, under the penalty of five pounds sterling for every offence.

I cannot more properly introduce an account of the projecting, conducting, and completing of this canal, which has opened a communication between the Atlantic and the British seas, and of which the advantages are so obvious, that they may be considered as the incentive to all succeeding improvements of the same kind, that have been or shall be made not only in the Highlands but throughout Scotland, than by some extracts from the second volume of a work published by Mr. Knox, in 1785:

Scotland is almost divided into two parts by the rivers Forth and Clyde. The Forth falls into the east sea below Edinburgh, and has a communication with the whole eastern coast of Great Britain; with France, Ostend, Holland, Hamburgh, Prussia, Dantzic, Russia, Sweden, Denmark, Norway, and Greenland. The Clyde falls into the Atlantic ocean below Glasgow, and communicates with the western coast of Great Britain, with Ireland, the south of France, Portugal, Spain, the Mediterranean, America, and the West Indies. These two rivers, thus falling in opposite directions into the two seas which environ our island, and the neck of land between them being scarcely twenty-four miles in breadth, suggested the idea of a junction between them, to open a communication across the kingdom, and thereby render unnecessary the long and dangerous navigation by the Land's End and the Pentland frith.

An object of such general utility did not escape the attention of
Charles

Charles II. (as has been before noticed) who, amidst all his gallantries, was the great promoter of every design which tended to encourage trade and navigation. That monarch proposed to open a passage for transports and small ships of war, at the expence of 500,000 l.; but the sum was much too great to be raised in his reign, and the design was consequently laid aside. The affairs of the continent engaged the attention of succeeding princes till the beginning of the present reign, when the earl of Chatham, endued with all the penetration and magnanimity of an able statesman, proposed to carry the design immediately into execution, at the public expence, on a smaller scale than the original plan, but still sufficient to admit vessels of burthen. Unfortunately the resignation of that great man, among other causes, prevented the execution of a project so beneficial to the security and expedition of the British navigation in the northern seas.

This scheme, thus abandoned a second time by the state, was now taken up by individuals, some of whom were suspected of private views, inimical to the general welfare of the community; and from this time forward we are to consider this great work as sacrificed to the hopes of gain, of influence, and to jobbing, both with respect to the course of the canal, and to its dimensions. Nature had pointed out Borrowstouness* on the Forth, and Dalmuire-burnfoot, six miles below Glasgow, on the Clyde, as the two extremities of this inland navigation; but such was the force of influence, that, instead of opening the east end of the canal at Borrowstouness, where there is water at neap-tides for ships of two or three hundred tons burthen, and safe lying, it was begun upon the river Carron, at the distance of a mile from its junction with the Forth, and four miles above Borrowstouness, where vessels of burthen could not float at neap-tides, besides the delay and inconveniences in navigat-

* Borrowstouness is, next to Leith, the principal trading town on the Forth; Dalmuire is a small village on the Clyde, washed by a rivulet called Dalmuire-burn, at the junction of which with the Clyde the canal is to be carried.

ing the Forth and the mouth of the Carron from floods and contrary winds, also a circuitous navigation of at least two miles.

The depth of water and dimensions of the canal came next under consideration, and gave rise to much controversy between the inhabitants of the east country on one part, and a considerable number of the inhabitants of Glasgow on the other. When we consider that the space to be cut did not, with all its windings, exceed thirty or thirty-two miles, and that this short navigation would at once open a communication between the two seas, and all the countries lying upon those seas, common sense pointed out the propriety of the greatest depth of water that the nature of the country would admit. This was the desire of the nation in general; and it would have been the interest of Ireland, and of London, Bristol, Liverpool, and other towns in England, to have subscribed towards a design in which their commerce, especially in time of war, was materially interested.

These considerations, however, were disregarded by the merchants; and those of the Scottish nation, who were friends to a deep canal, seeing themselves overpowered by their opponents, submitted reluctantly to an imperfect navigation. Mr. Smeaton, an able engineer from Yorkshire, had estimated the expence of four, seven, ten, and fourteen feet water. Certain merchants of Glasgow adopted the scale of four feet, which, though sufficient for the trade of that city, would scarcely have answered any valuable purpose to the nation in general; and it was suggested, no doubt invidiously, that those persons never meant that the canal should join the Clyde. While a bill for cutting the proposed ditch of four feet water was before parliament, and on the point of being passed, the east country gentlemen and traders took the alarm, objected to the frivolousness and partial utility of the plan, and, fortunately for the public, obtained a bill, extending the depth of water to seven feet. It now became necessary to open a subscription, to the amount of

150,000*l*.

150,000 l. which was soon filled; and about 130,000 l. was actually paid.

Mr. Smeaton began this arduous task in 1768, and overcame almost insurmountable difficulties till he had got to the extent of nine miles, when, on account of some misunderstanding between him and the managers of the canal, he resigned that business.

Two strangers from Yorkshire soon presented themselves, and discoursed on the subject with such plausibility, that they were immediately engaged to carry on the work. When these men had completed about nine or ten miles, they were discharged, and Mr. Smeaton was again employed.

The work was now conducted upon the original principles, till it was brought within sight of the Kelvin, and six miles from the proposed junction with the Clyde; when the subscription, and a subsequent loan, being exhausted, beyond which the proprietors were unwilling to proceed, the work was stopped in 1775. The inhabitants of Glasgow, however, by means of a collateral branch, nearly three miles in length, have opened a navigable communication from that city to the Forth; and thus the emporium of the north communicates with both sides of the island.

After the experience of several years, the navigation by the river Carron was found so inconvenient, that a new subscription was proposed for opening a communication from Borrowstouness, to join the canal near Falkirk; and in 1784 a bill was obtained in parliament for that purpose; of which an abstract has before been given.

This work, when finished, will affect the Carron navigation, though every possible effort has been made to shorten that passage. Some years ago a cut was made near the mouth of the river, to shun a bend or reach;

and in 1784 the proprietor of the adjoining lands put himself to the expence of a second cut, by which the Carron river is now totally avoided. It is a mile in length, and navigable for vessels of large burthen. Had this cut been made at first, there would have been no rivalry from Borrowstouness; but the whole business has been a series of blunders and unnecessary expence, in which the public-spirited proprietors are equally involved with those whose selfish views have proved so detrimental to the whole design in all its stages. The money expended, down to 1783, amounts to 212,000 l. No dividend has yet been made, or can be made, until the debts shall be discharged; when it may be supposed that the total expenditure will be increased to 220,000 l. or 11,000 l. per annum, while the tonnage, one year with another, does not amount to 7,000 l. About six miles, and those the most difficult in the whole tract, remained to be finished in 1784; for which government has allowed 50,000 l. from the forfeited estates. If to this sum we add the Borrowstouness expenditure, and the two subsequent cuts at the mouth of the Carron, this canal will cost 300,000 l. or upwards, previous to the first dividend; while at the same time, the tonnage is rated so high, that vessels carrying bulky goods sometimes prefer the long passage by the Pentland frith.

The dimensions of this canal, though greatly contracted from the original design, are much superior to any work of the same nature in South Britain. The English canals are generally from three to five feet deep, and from twenty to forty feet wide, and the lock-gates from ten to twelve feet; but they answer the purpose of inland carriage from one town to another, for which alone they were designed. The depth of the canal, between the Forth and Clyde, is seven feet, its breadth, at the surface, fifty-six feet: the locks are seventy-five feet long, and their gates twenty feet wide. It is raised, from the Carron, by twenty locks in a tract of ten miles, to the amazing height of one hundred and fifty-five feet above the medium full sea-mark. At the twentieth lock begins the canal of partition, on the summit between the east and west seas; which canal of partition continues eighteen miles on a level, terminating
at

at Hamilton-hill, a mile north-west of the Clyde at Glasgow. In some places the canal is carried through mossy ground, and in others through solid rock. In the fourth mile of the canal there are ten locks, and a fine aqueduct bridge, which crosses the great road leading from Edinburgh to Glasgow. The expence of this mile amounted to eighteen thousand pounds. At Kirkintulloch the canal is carried over the water of Logie on an aqueduct bridge, the arch of which is ninety feet broad, and was thrown over in three different stretches, of thirty feet each, having only thirty feet of a centre, which was shifted on small rollers from one stretch to another. Though this was a new thing, and never attempted before with an arch of this size, yet the joinings are as fairly equal as any other part of the arch. The whole is thought to be a capital piece of masonry. There are in the whole eighteen draw-bridges, and fifteen aqueduct-bridges, of considerable size, besides small ones and tunnels.

The supplying the canal with water was of itself a very great work. One reservoir is above twenty-four feet deep, and covers a surface of fifty acres, near Kilsyth. Another, about seven miles north of Glasgow, consists of seventy acres, and is banked up at the fluice twenty-two feet.

Upon the whole, this canal, when finished, will be one of the greatest works completed in Britain since the time of the Romans. There are twenty locks already finished; the remaining six miles will require nineteen more. But the most expensive part of the work will be to carry the canal over the Kelvin river, a considerable body of water, which in wet weather sweeps every thing before it: the depth of the Clyde at Dalmuire-burnfoot, in spring-tides, is fifteen feet, and at Dunotter, half a mile below, eighteen feet.

The proprietors now are more sensible than ever of their error, in not forming a cut of ten feet water; and proposals have been made to raise
the

the banks, so as to obtain eight feet ; but this, though practicable, would prove expensive, and possibly a fruitless attempt. Were we to speculate upon the probable increase of trade, commerce, and wealth in that part of the kingdom fifty years hence, 100,000 l. may then perhaps easily be raised to deepen the canal two or three feet, which would be a more effectual improvement than raising the banks ; and with a reference to this idea, I asked Mr. Smeaton, among other questions, whether the remaining six miles might not be constructed for nine or ten feet water ? “ The banks,” said he, “ may be raised a foot ; but you have put another question, that requires some consideration to answer with safety.” If this depth can be effected, it would certainly be rendering posterity an essential service to make the alteration, though the extraordinary expence should amount to twenty, or perhaps five and twenty thousand pounds.

The canal at present, when clear, admits loaded vessels of seventy or eighty tons, and when completed, may be navigated by those of a hundred or upwards, built and rigged on a proper construction. Ships passing this canal ought to be built on the same plan with those employed by the Dutch, and by the traders of Hamburgh, Dantzick, and other towns on the Baltic ; that is, long and flat-bottomed, with lee-boards. All vessels or lighters proper for navigating large canals, should be fitted out and rigged with one mast, either as a sloop or galliot ; having one yard aloft, they can take no wind-hold, so that they can easily pass the canal, when a square-rigged ship could not attempt it ; not to mention the detriment done to the locks and banks by high-rigged vessels.

There are vessels at present in the London trade from Leith, that carry a hundred and thirty tons, drawing only eight feet water, and a small alteration in this model will bring them to seven feet ; consequently, when the canal is completed, vessels of that burthen may trade from the Clyde to the Baltic, Holland, and all parts of Great Britain, without unloading at the entrance of the canal, or any impediment whatsoever, except from occasional frosts in the winter, and droughts in the summer,

summer, to which all inland navigations, whether natural or artificial, are subject.

Canals, unless frequently cleaned, are apt to fill up in certain parts; and though the above-mentioned cut was originally seven feet deep, no vessel drawing above six feet and a half can navigate it, unless the practice of shipping in shallow-bay harbours be adopted. As most vessels draw more water in the stern than in the bow part of the ship, they are trimmed on an even keel till they have passed the shallows; and by this method half a foot of water may be gained.

Busses, and other unavoidably sharp-bottomed vessels, belonging to the Clyde, may also pass the canal by means of lighters; the expence of which cannot be great, nor would any additional tonnage be charged.

Upon the whole, this canal, even in its contracted state, will exceed the most sanguine hopes of the public with respect to its general utility. The distance between the entrance into the Clyde and the Forth is, by the Pentland frith, six hundred miles; by the canal scarcely one hundred. But this disproportion of distance, in a sea-voyage, is trifling, when compared with the delays, the shipwrecks, the positive and casual expences attending a passage by the Hebrides and the Pentland frith, or even by the Land's End, particularly in time of war, when the charge of insurance is from 15 to 20 per cent. while by means of the inland navigation it seldom exceeds 5 per cent.

I have before observed, that the canal was stopped in 1775, but that a collateral cut was carried to Glasgow. I have also mentioned the act passed in 1784, for giving further powers to the proprietors, and extending the canal to Borrowstouness, and also the grant of 50,000 l. which government allowed from the forfeited estates in Scotland, for this and other public works; when in the beginning of the year 1785 the undertaking was again revived.

Mr. Smeaton having declined the business on account of his bad state of health, or some other motive, Mr. Robert Whitworth, a gentleman of approved abilities, was employed in finishing this canal, which was entirely completed on the 28th of July, 1790, when the public opening of the Forth and Clyde navigation from sea to sea was made by the sailing of a track-barge, belonging to the company of proprietors, from the basin of the canal, near the city of Glasgow, to the river Clyde, at Bowling-bay. The voyage, which is upwards of twelve miles, was performed in less than four hours, during which time the vessel passed through nineteen locks; descending thereby one hundred and fifty-six feet from the summit of the canal into the Clyde. It required only four minutes to pass each of the locks; in which space the lock descended eight feet into the reach of the navigation immediately below. In the course of the voyage from Bowling-bay, the track-boat passed along that stupendous bridge, the great aqueduct over the river Kelvin, four hundred feet in length, exhibiting to the spectators, in the valley below, the singular and new object of a vessel navigating seventy feet above their heads; a circumstance which gives this great work a pre-eminence over every thing of a similar kind in Europe, and does infinite honour and credit to the professional skill of that able engineer, Robert Whitworth, Esq; under whose direction the remainder, and most difficult part of this great undertaking, has been completed in a truly masterly manner.

The committee of management, accompanied by the magistrates of the city of Glasgow, were the first voyagers on this new navigation. On the arrival of the vessel in Bowling-bay, after descending from the last lock into the Clyde, the ceremony of the junction of the Forth and Clyde was performed by Archibald Spiers, Esq; of Elderslie, chairman of the committee of management, who, with the assistance of the chief engineer, launched a hoghead of the water of the river Forth into the Clyde, as a symbol of joining the eastern and western seas together. This great event, so important to the trade and navigation of Great Britain,

Britain, and particularly to the towns of Liverpool, Lancaster, Whitehaven, Greenock, Dublin, Newry, Drogheda, Belfast, Londonderry, &c. &c. on the one side, and the towns of Lynn, Hull, Newcastle, Leith, Dundee, Aberdeen, &c. &c. on the other, as also to all the ports in St. George's Channel that trade to Norway, Sweden, and the Baltic, has opened a communication which not only shortens the distance from eight hundred to a thousand miles, but also affords a more safe and speedy passage, particularly in time of war, or at the end of the season when ships are detained long in the Baltic, and cannot attempt the circuitous sea-voyage without great danger of spoiling their cargoes, or being too late for their market. The whole length of this canal navigation, from the Forth to the Clyde, is exactly thirty-five miles, sixteen of which is, upon the summit of the country, one hundred and fifty-six feet above the level of the sea; to which height the vessel is raised by means of twenty locks from the eastern sea, and nineteen from the west. Each lock is twenty feet wide, and seventy-four feet long between the gates. The depth of the canal is precisely eight feet throughout, and the medium width fifty-six feet on the surface of the water, and twenty-eight feet at bottom.

The toll-dues payable on the navigation are two-pence per ton per mile, or five shillings and ten-pence per ton for the whole length of the canal; and the time required to pass from sea to sea through the thirty-nine locks will be about sixteen hours. At Bowling-bay, about the distance of nine miles from the entrance, and near the great aqueduct over the river Kelvin, there is a commodious dry dock for careening and repairing vessels, where every accommodation is afforded to ship-owners on moderate terms.

Upon the whole, it must be generally admitted that no public work in Great Britain was ever so complete in all its parts, or promised so many advantages to the trade of the country at large; and upon few occasions has such general satisfaction been expressed on the approach

of that period when the real utility of this splendid undertaking will become apparent to the public, and which, it is to be hoped, will soon be succeeded by two more canals, northwards towards the Highlands, which will be equally useful, although not equally lucrative, to the undertakers; and of which I shall immediately proceed to give a short account: but first I shall present the reader with a concise recapitulation of particulars relative to the canal I have been describing.

Summary View of the Canal from Forth to Clyde,

	Miles.
The rise of the canal from lock No. 1 at Grangemouth, to lock No. 20 at the summit of the navigation, is one hundred and fifty-six feet, and extends	10 $\frac{1}{4}$
The summit of the canal, or head level, from lock No. 20 east, to the point of partition at lock No. 21, is in length, and extends	16
The fall of the canal from lock No. 21, at the end of the summit of the navigation, to lock No. 39 in Bowling-bay, is one hundred and fifty-six feet, and extends	8 $\frac{3}{4}$
Extreme length of the navigation from lock No. 1 on the river Forth, to lock No. 39 on the river Clyde, is	35
Extreme length of the collateral cut to Glasgow	2 $\frac{3}{4}$
	Feet.
Medium width of the surface of the canal	56
Ditto of bottom of the canal	27
Depth of the canal from sea to sea	8
Fall of each of the thirty-nine locks on the canal	8
Width of each lock	20
Length of each lock, clear within gates	74
	193
	The

The canal, in its course from the Forth to the Clyde, passes over ten large aqueducts or water-bridges, and thirty-three small aqueducts and tunnels; in all forty-three.

There are also thirty-three draw-bridges over the canal.

Tonnage-dues are two-pence per ton per mile.

Ditto from sea to sea five shillings and ten-pence.

From Grangemouth to Glasgow the tonnage is four shillings and ten-pence, and from Bowling-bay to Glasgow two shillings.

A short Account of an intended Navigation between the Atlantic and Lochfyne.

I shall here again make a short extract from Mr. Knox.

“ Having finished my observations on Loch Gilp, I set out with an intelligent person of that neighbourhood for Loch Crinian, on the west side of the peninsula. The ground rises almost imperceptibly to the height of eighteen feet above the sea; and the whole is composed of the most favourable soil, neither too hard nor too soft. It is properly a level valley, partly plowed and partly in grass, environed by hills on the north and south. Nearly at the centre of the valley a rivulet divides itself, by falling into two opposite directions. One part runs east into Loch Gilp, and the other into Loch Crinian on the west. This is properly the point of partition. The rivulet is supplied by numerous rills from the high grounds on each side; a most favourable circumstance for the purposes of a canal.

“ Thus the cutting five, or at most six miles, would answer every valuable purpose in that division of the kingdom, but more particularly to the Highlanders, who, by finding themselves brought nearer by a hundred miles to Glasgow, and its communications with other parts of the island, would gradually forget the grievances under which they have laboured. A voyage which frequently takes three weeks, would by this easy passage be performed in three or four days in all seasons of the year, whether in time of peace or war. By thus cutting off the peninsula of Cantire, the voyage from Glasgow to the Hebrides would be entirely inland, and thereby screened in a great measure from the dreadful tempests of the Atlantic.”

The expence of a canal of ten feet water, and fourteen locks, is estimated by Mr. Watts, the engineer, at 48,405 l. but as large buffes, being sharp bottomed, will require, when full loaded, eleven feet water, and as it is proposed to admit vessels of 120 tons for the herring fishery, I conceive that twelve feet will be more than sufficient for the purpose of fisheries. But there is another object of very considerable importance, though hitherto unnoticed, for which a deep water canal at this place would be essentially useful ; that is, the expedition, facility, and security by which troops and military baggage would be conveyed between the Highlands and the Clyde, where the troops take shipping for the places of their destination.

I am happy to hear that the expediency of this navigation is now generally admitted, and that persons of rank have it seriously in contemplation. It would still be more pleasing were government to undertake the completion of it at the public expence *. Highways, inland navigations, the forming or repairing of harbours, have in all ages and countries, Great Britain excepted, been considered as public works, and

* Dr. Anderson advises that this work should be completed by private subscription.

consequently

consequently executed by the public. In this manner Ireland, France, Denmark, Sweden, and the American States, are at present carrying on very extensive inland navigations. England, whose revenue far exceeds that of Ireland, Denmark, and America united, leaves these great national objects to the local views of traders and speculators who clog the national commerce with excessive tonnage, which they demand to reimburse them for the money they have laid out, and for annual repairs. Thus the canals in England, works which should be conducted upon the boldest plans, are stinted in every particular, and executed imperfectly; of which various instances might be produced, though now too late for any effectual remedy.

Description of the intended inland Navigation between Inverness and Fort William.

A THIRD northern navigation, of very considerable utility, also claims the attention of the public. Between the sound of Mull on the west, and the Murry firth on the east side of the kingdom, there is a level or chasm composed of land and water, which separates the mountains of the middle division from those of the north so completely, that, with the assistance of art, ships might pass between them from sea to sea.

On the west side of this extensive valley is the Linnke Loch, penetrating from the sound of Mull twenty-four miles north-east, and so capacious that ships of the line have been moored as high as Inverlochy, now known by the name of Fort William, or Maryburgh. This fine salt-water lake communicates with Loch Creran, Loch Leven, and Loch Eil, all of which are navigable for vessels of burthen, to which they afford a safe retreat when the violent gusts of wind render the Linnke navigation dangerous.

The fish peculiar to these waters, are herrings, whitefish, salmon, trout, and phinoes, supposed to be the young of what the fishermen call the great trout, some of them weighing thirty pounds. The timber is birch and pine.

The proposed line of communication from Fort William to Inverness lies in an eastern direction, and is fifty-three miles in length; the first branch of which is the river Lochy, issuing from the loch of the same name, at the distance of seven miles and a half. It is a considerable river, very rapid, and has a fall of eighty feet. Loch Lochy is a beautiful sheet of water, ten miles and a half long, half a mile broad, thirty fathom deep where deepest, and never freezes. It abounds in salmon, trout, and other fish peculiar to fresh-water lochs: the banks are shaded with natural woods.

At the distance of a mile on the north side of this loch is Loch Arkek, nearly of the same dimensions with the former; the banks of which are shaded with very extensive woods of fir.

Keeping due east, in the line to Inverness, there is a space of two miles without any river: the soil, gravel and earth. This may be called the canal of partition, being the highest ground in the whole extent of the valley between the two seas, and rises twenty-two feet above Loch Oich, to which it is joined on the east. Loch Oich is four miles long, a quarter of a mile wide, and of sufficient depth for the purpose of navigation. Its surface is about a hundred feet above high-water at neap-tides. Its banks and some small islands are beautified with woods. Here is also lime-stone sufficient for the supply of the whole country from sea to sea, as soon as the navigation shall be completed.

Near the head of Loch Nevish, on the western ocean, facing the isle of Sky, issues a rivulet, called Joine Water, which after a short course
falls

falls into Loch Quich, which is eight miles long. From thence the united waters keep a south-east direction for twelve or fifteen miles, when they fall into Loch Garry, which is six miles long. Two miles farther these combined streams reach Loch Oich, from whence a river of the same name flows five miles eastward into Loch Ness. This river has a fall of fifty-five feet, over a gravelly bottom from thirty to forty yards wide.

Loch Ness, the glory of the northern Highlands, is twenty-two miles long, from one to two miles broad, and from five to a hundred and forty fathoms deep. This loch has some qualities peculiar to itself, some few waters excepted: it never freezes; and in winter it is covered with a steam or smoke proportioned to the severity of the weather. It even softens the rigour of the air in the northern climate, and assists vegetation, particularly the growth of trees, which on the south side form one continued wood of small birch, ash, and oak. Its waters are also salubrious, and extremely favourable to longevity. The fish found in them are salmon, trout, pike, and eels. The surrounding woods and mountains of this loch, and the whole tract which I have been describing, besides small cattle, sheep, and goats, are frequented by stags, roes, harts, ptarmigans, grouse, and black game; as also the rare bird called the capercally, or cock of the wood. The principal waters which supply this lake, exclusive of the Oich, before-mentioned, flow from the western coast to Loch Clunny, and from thence through a valley of many miles, called Glen Morrifon, where they fall into Loch Ness, near Fort Augustus.

From the eastern extremity of the lake issues the river Ness, gliding in a copious stream through a tract of eight miles to Inverness, where it falls into Loch Beaulie, a capacious salt-water lake, which communicates with the sea at a narrow strait called Anderfier, guarded by the modern
Fort

Fort George. The river Nefs flows over gravel, and is from forty to eighty yards wide. Its greatest depth is four or five feet, the declivity of the surface forty-five feet. The tide flows about a mile above the town; but, on account of floods and other obstructions, the cheapest and most effectual navigations would be by cuts along-side of the rivers, which it has been found are practicable. The whole line of communication, from the sound of Mull to Inverness, comprises an extent of eighty-two miles, and is thus composed of land and water, viz.

Loch Linnke 24 miles, Loch Lochy 10, Loch Oich 4,	
Loch Nefs 22—in all	60 miles.
River Lochy 7 miles, river Oich 5, river Nefs 8—in all	20 miles.
Land from Loch Lochy to Loch Oich, the level 122 feet	
above high-water at neap-tides	2 miles.
	82 miles.

Width of the canal 70 feet, depth 10 feet, length of the locks 90 feet, width of the locks 25 feet.

	Miles.
The navigation saved in a voyage from Inverness to the Sound of Mull	200
Ditto from Buchaness to ditto	127
Ditto to vessels keeping the outside of the Orkneys at seasons when the Pentland frith cannot be navigated	187

Vessels drawing nine feet water might pass from Inverness to Fort William in three days; small craft much sooner. The voyage by the Pentland frith is upon an average two weeks, and frequently two months.

The objects of this northern navigation are for the most part similar to those of the south; but the expence will be nearly in proportion of three

three to one, viz. the southern canal 60,000 l. the northern ditto, 164,000 l. besides the value of grounds to be purchased *.

* Dr. Anderson's report to the Lords of the Treasury, is as follows :

The following is Mr. Watts's survey and estimate of Loch Crinian and Loch Gilp passage :

By the Crinian and Loch Gilp passage the total distance between high-water mark on each side the isthmus is six miles and one half; the greatest rise above high-water neap-tides is seventy-five feet.

The following is Mr. Watts's survey and estimate by the Tarbet passage :

The expence of a canal seven feet deep is estimated at 34,879 l. Ditto ten feet deep, 48,405 l.

By the Tarbet passage, the total distance between high-water mark on each side the isthmus is one mile; the greatest perpendicular rise above high-water at neap-tides, is forty-five feet.

The expence of a canal of seven feet deep, is estimated at	—	£.
Ditto of a canal ten feet deep	—	17,988
Ditto of a thorough cut, without locks, of twelve feet deep at high-water	—	23,884
Ditto of ditto at fifteen feet deep	—	73,849
		120,789

Mr. Watts's survey and estimate of a canal with ten feet water, from Fort William to Inverness.

The canal upon the Nefs, eight miles, rise forty-five feet, takes up one hundred and twenty-one acres of land—Expence ———— 34,656

The canal upon the Oich, five miles, rise fifty-five feet, occupies one hundred and one acres of land ———— 37,699

Greatest rise one hundred feet ————

The canal on the summit, descending two miles, rise twenty feet, occupies fifty-nine acres one quarter of land ———— 28,286

The canal of Lochy, descending seven feet and a half, rise eighty feet, occupies one hundred and seventy-two acres and a half of land ———— 63,389

£. 164,030

The length is the same as I have given before from Mr. Knox.

C H A P. XIII.

Account of the Canal from Dublin to the Shannon, in Ireland.—Various Reports of different Engineers on the Difficulty of cutting this Canal, which is not yet completed, notwithstanding the immense Sums it has cost.—Resolves of the Canal Company with respect to the carrying on the Work, and finding Materials.—Account of the Newry Canal.—Extracts from A. Young's Tour through Ireland.

I R E L A N D.

An Account of the navigable Canal from the City of Dublin to the River Shannon.

THIS grand canal, from the city of Dublin to the river Shannon, was originally planned by Mr. Omes (the engineer to the Lagan navigation), and carried on under his direction from Dublin into the bog of Allen, at the expence of seventy-seven thousand pounds. When the work was advanced thus far, it was discovered that several capital mistakes had been committed in the levels, the water in some places of the canal standing four or five feet deeper than in others; in consequence of which, the work being almost at a stand, in the year 1770, the members of the right honourable and honourable navigation boards called in Mr. Vallancy, who subscribes himself "Director of Engineers," to survey the works, and advise what was proper to be done: but the lord mayor and corporation of Dublin, who had the success of this work much at heart, not being satisfied with Mr. Vallancy's survey and report, called in Mr. John Trait, engineer, who differed very widely from Mr. Vallancy,

Vallancy, in almost every part of his survey and report; and has in general assigned good reasons for so doing. Since that time some other engineers have been consulted; yet after all the sums of money that have been squandered away, this canal is far from being completed.

The failure of this great work, which at first might have been so very easily completed at a moderate expence, may justly be attributed to the want of an accurate and well digested plan and survey; for it does not appear there were any material difficulties in the whole line, but what might have been overcome with great ease, had the work been properly conducted by an able and experienced engineer; since neither money nor a proper attention to its being laid out judiciously was wanting, as may be seen by the resolves of the company of proprietors, which I here subjoin, to shew how careful they were to be properly supplied in time, and prevent the work standing still for materials or utensils.

RESOLUTIONS of the Company of Proprietors of the Canal Navigation
from the City of Dublin to the Shannon, 1771.

“ Resolved, That the best, most regular, and effectual method of directing and carrying on the business of the company, and the great national advantages and purposes of their incorporation, is by select committees to be chosen by ballot.

“ Resolved, That a select committee of forty-one members be appointed, and called the Court of Directors, any five of whom to be a quorum; that they do meet weekly on every Tuesday morning, or oftener if they shall think fit (upon the summons of the secretary, ordered by three of the court of directors), in the city of Dublin, or in any other place they shall think proper; which court of directors shall have power to carry into execution all resolutions, orders, rules, and regulations of the company; to order summonses for calling general

U u 2 meetings

meetings so often as they shall see occasion, giving regular notices thereof: that they shall have full power and authority to direct and regulate the carrying on and management of the navigation of the grand canal, and all works thereon, and the purchase and management of all ground and land necessary for carrying on the same, or belonging thereto: also that they shall have the controul and direction of all officers and servants belonging to the company and navigation, who are to receive their orders and directions from the general board and the court of directors only: that all money for carrying on the navigation, and all other purposes of the same, be paid and disposed of under the general board and direction of the court of directors only; five of the said court to sign such orders: that all committees do receive instructions from the court of directors, and make their reports to them; and in general that the said court of directors do regulate and prepare all business for the general board and meetings of the company; provided always, that the said court of directors do not in any sort suspend, invalidate, alter, or contradict the regulations, rules, or orders of the general boards, but the same shall be binding and conclusive to them, who are to take care to have the same carried into execution.

“ Resolved, That a select committee of thirty-one members be appointed, and called, *The Committee to superintend the Works carrying on upon the Canal*; any three of whom to be a quorum: and they are to view and inspect the said works, and report to the court of directors, from time to time, how the same are carrying on; and if any fraud, mismanagement, or impropriety appears to them, that they do lay the same before the court of directors of the company, &c. &c.

“ Resolved, That a select committee of twenty-one members be appointed, and called, *The Committee of Accounts*; that they or any five of them do settle and adjust all accounts of receipts and payments of all money belonging to the company; and all bills and accounts relative to

to money are to be laid before them, and to be regulated and settled by them, &c. &c.

“ Resolved, That a select committee of twenty-one members be appointed, and called, *The Committee to superintend the Stores* ; any three of whom to be a quorum : that they do view and inspect the stores, and all timber, iron, machines, utensils and materials brought into the same, or made use of in or about the said works, &c. &c.

“ Resolved, That all the said four committees shall continue until the second Tuesday in November, yearly, and until other committees are chosen and appointed, &c. &c.

“ Resolved, That the committee to superintend the works, and the committee of stores, do meet on the first and third Thursday in every month, and the committee of accounts every Thursday, weekly ; and that the said meeting of all the said committees be at twelve o'clock each day at the Navigation Board House, or at such other place, and as often beside the above meetings as the said respective committees, or any three of them, shall under their hands direct the secretary to issue summonses for.”

Then follow several other resolves and orders relative to the expenditures, balloting for committees, and reports for the well-governing and conducting the business.

Then follows their agreement for a contract with the city of Dublin to supply the city with water from the canal, and their contract with the Navigation Board, to be paid by the city one thousand pounds, when and as often as the canal company has laid out and expended on the said canal five thousand pounds.

Then follow the forms of their debentures and transfers ; also their deposits, and common seal of the company, and their time of calls for payment,

payment, which are as usual, and not of sufficient importance to merit being repeated here.

The resolves relative to the different officers, their salaries, duties, and the mode of their election, are as follow :

“ Resolved, That a secretary be appointed, at a salary of one hundred pounds yearly.

“ Resolved, That it is the duty of the secretary that he do issue notices of meeting, attend and take the minutes of the company and their committees at their several meetings, receive all letters, memorials, and petitions, write all letters that shall be ordered, and obey all orders; make out reports of all committees, enter the proceedings of the company in a general minute journal, and those of the several committees in a committee journal; and that he attend at stated days for transferring stock, and make regular entries of the same.

“ Resolved, That a pay-clerk be appointed, at a salary of fifty pounds per annum.

“ Resolved, That the duty of the pay-clerk be, that he do attend on the canal every Saturday, and at such other times as shall be required by the engineer, to receive the returns from the overseers of the number of labourers employed under them, and to pay them in silver, if required, the amount of their several returns, make up accounts weekly of the amount of each week's payments, and on passing them verify them on oath, and pay the engineer's drafts in town.

“ Resolved, That a treasurer to the company be appointed.

“ Resolved, That an engineer be appointed to the company, for conducting the navigation.

“ Resolved,

“ Resolved, That the engineer be allowed, for himself and his clerks, five pounds per cent. upon all sums which shall be expended upon the works only, from the 21st of July, 1772 ; and that he be paid annually the sum of three hundred pounds, to be deducted from the said five per cent. as a subsistence for himself and clerks, until the work shall be completed from Dublin to the river Liffy ; the balance to be paid him when such part of the work shall be so completed.

“ Resolved, That a general store-keeper be employed in Dublin, at a salary of forty pounds per annum.

“ Resolved, That the duty of the said officer shall be to receive, and take into his care such implements, utensils, &c. as shall be sent to him, provided that he receives with them an order under the engineer's handwriting for such implements, &c. which order he is to file, and give in return his receipt, and that receipt is to be given to the engineer ; and whatever timber is cut up in the store-yard he must keep a regular account of, and the purpose to which it was converted. The store-keeper is to act as overseer of the men who shall from time to time be employed in the store-yard, and to make such returns, that when called upon he may be able to verify their exactitude upon oath.

“ Resolved, That the several officers belonging to this company shall be elected annually on the second Tuesday in November.”

ORDERS for regulating the WORKS.

“ Ordered, That the engineer do build the locks upon the grand canal eighty feet long, clear pool, and sixteen feet in breadth ; and that he do also build the same with hewn stone, in the most perfect and permanent manner.

“ Ordered, That the engineer do immediately erect mile-stones on the

the banks of the grand canal ; the first at one mile from the city basin, and one at the end of each mile as far as the works are carrying on.

“ Ordered, That as soon as the mile-stones shall be erected on the banks, the several overseers be required to distinguish in their weekly returns, not only the denomination of land on which their several men have been at work, but also within what particular mile ; distinguishing also each species of work, or article of expence.

“ Ordered, For the more exact regulation of the workmen with regard to the hours of labour, that a chamber alarm-clock be provided, to be fixed up in the engineer's place of residence on the line ; and that he do cause the same to be regulated by the post-office clock ; and that he do direct the several overseers to regulate their several watches thereby.

“ Ordered, That no person who keeps a public-house, or is any way concerned in the keeping one, shall be employed as an overseer of men, or carts that shall be used in carrying on the navigation.

“ Ordered, That a driver be required to attend two carts that shall be employed on the works of the company.

“ Ordered, That a contract be immediately entered into with Matthew Gamble for sinking the earthy part lying in the bed of Gollerstown quarry, and carrying it off to any proper distance the engineer shall direct, at three-pence per cubic yard for sinking, and clearing out to a proper distance all the quarry-stone lying in the line of the grand canal, from Gollerstown bridge to Stachumney lock-house, down to a proper level at the bottom, as shall be directed by the engineer ; the said Gamble finding his own powder, pumping water, and keeping tools, barrows, and pumps in repair at his own expence, till worn out, then the same to be returned to the company's stores, and replaced to the said Gamble by new ones, at one shilling and ten-pence per cubic yard : and also,

also, that for preserving and raising all quarry beds found in the said quarry that shall be fit for cut-stone of every denomination, and for cutting and setting the same, to be measured when set, at twelve-pence halfpenny per foot, the said Gamble to be allowed to draw subsistence weekly for stone-cutters and labourers in proportion to their wages, and to have a general settlement once every quarter of a year. The said Gamble also to employ as many men of every denomination as shall be thought necessary, and to produce two undeniable persons, each in five hundred pounds security, for the due performance of his contract. The company to furnish the said Gamble with engines, ropes, tools, planks, and pumps of every kind, which the said Gamble shall keep in repair as is aforesaid.

Ordered, " That a contract be entered into with Mark Byrn for sinking and clearing out the level of the canal between Gollerstown-bridge and Bally Keally at one shilling and nine-pence per cubic yard, as specified in the proposal.

ORDERS for regulating STORES.

Resolved, " That all tradesmen to be employed in the navigation of the grand canal, be recommended by the committee of stores to the court of directors for their approbation.

Resolved, " That the quantity, rates, and prices of all timber, iron, utensils, and materials necessary, be reported from time to time by the committee of stores to the court of directors for their consideration.

Resolved, " That no article be used, or placed to the credit of the company, till approved, &c. by the committee of stores.

Resolved, " That a competent number of spades, shovels, pick-axes, crows, wheelbarrows, hand-barrows, and such like utensils, be provided, and lodged in the stores for the use of the navigation, and given out oc-

casionally by the order of the engineer; and that the person to whom they are given do give a receipt to the store-keeper for the same, and that at proper times, and when called upon, such person do account with the store-keeper for such articles; and that in case he shall not produce the same, allowing reasonable wear and tear, the value of such articles not produced shall be paid for, or stopped out of the hire or wages of such person.

Resolved, " That the overseers give security, if required, for the tools delivered to them, and return them into the store-house when worn out or broken, that they may be mended, and others delivered out in their room.

Resolved, " That carpenters, bricklayers, stone-cutters, masons, and joiners, hired and employed by the day, be not supplied with tools.

Resolved, " That the engineer do from time to time examine the stores, and constantly have them supplied with patterns and models of all common iron and timber implements, necessary for the navigation, made up in the best and most workman-like manner; and that he do also from time to time lay before the committee of stores accounts of what timber, iron machines, and materials, as likewise what number of spades, shovels, pick-axes, crows, wheelbarrows, hand-barrows, and other utensils, may be wanting for the use of the navigation, so that they may be provided upon the best terms, and in convenient time, before they are immediately wanted.

Resolved, " That the most effectual, cheap, and expeditious method of providing lock-gates, screw-pumps, square-pumps, windlasses or capstans, two and four-wheel trucks (exclusive of iron work), will be to have them made by contract in the store-yard, the company supplying the timber; and that an advertisement be published for that purpose.

Resolved,

Resolved, " That it is necessary and proper that a carpenter, of approved abilities and character, who will engage to give his whole attention to the company's works, under the direction of the engineer, be engaged ; and that an advertisement be published for such persons to give in their proposals to the secretary.

Resolved, " That the several patterns of tools and utensils, sent in by Mr. Trail in pursuance of the order of the court of directors, be not made use of in the works, but be set apart and preserved for the purpose of comparing with them the like tools which shall be provided by contract.

Resolved, " That care be taken in the contract for iron and smith's work, positively to specify that the several tools shall be wrought out of bar iron, and not made in moulds.

Resolved, " That the committee of stores do meet in the store-yard every Friday ; and that notice be given to the several persons furnishing stores, to bring them in on a Thursday, to be inspected the next day by the committee; the contract for iron work to be sealed up ; and the patterns or models of iron and timber implements to be lodged in the store-house for the inspection of the committee.

Resolved, " To enter into the contract proposed for supplying all kind of iron and smith's work that may be wanted for the navigation, at the average price of four-pence halfpenny per pound.

Resolved, " That the proposed contract be accepted and entered into for supplying the company with wheelbarrows at nine shillings, hand-barrows at two shillings and six-pence, shovel and pick-axe handles at five-pence each ; and for making two-wheeled trucks at one pound eight shillings, and four-wheeled trucks at two pounds five shillings and six-pence."

Several other rules and orders were also made, which it is not necessary particularly to enumerate.

The course of this canal is from the city of Dublin over the rivers Little Mouell and the Great Mouell, and then across the river Liffy, by Dowingo and the Isle of Allen into the bog of Allen, and into the river Maiden at Tullimore, which goes into the Brufna river, and falls into the river Shannon near Moys-town. A canal is cut out of the grand canal in the middle of the bog of Allen into the river Boyne at Edenderry, and another near Clonbullock, into the river Barrow to Monasteraven, and into another branch of the same river at Portarlinton; another cut is also made to Naastown, and a fourth to Johnstown. Several more cuts, equally useful, are in contemplation, the navigation being far from complete. The whole length of the cut from Dublin to the Shannon is sixty-one miles and a half.

I have before observed, that the expence of carrying the canal through the bog of Allen, to the year 1770, when a stop was put to it till further and more accurate surveys should be taken, was 77,000 l. New surveys have been since made, and other engineers appointed; but notwithstanding the vast quantity of money laid out, or rather squandered away upon it, to the amount of upwards of 300,000 l. it still remains unfinished; and a very intelligent gentleman, who travelled through Ireland from motives of pleasure and curiosity, assured me, in August 1790, upon his arrival in England, that he had the most authentic information, that this grand canal, with all its faults and blunders, has already cost above half a million of money, yet was still far from being completed; and is in fact what may be called a mere job.

I shall conclude what I have to say on the canals in Ireland, with an extract from a celebrated performance* on the present state of Ireland, which comes down to the year 1780.

* A Tour through Ireland, by A. Young, Esq; F. R. S.

“ I made

“ I made some inquiries (says the writer of that work), and travelled many miles to view some of the navigations ; and the only one which appeared to me really completed, is the canal from the town of Newry to the sea, on which I saw a brig of eighty or a hundred tons burthen. The same canal is extended farther than that town, but stops short of the great object for which it was begun and made, viz. the Drumglafs and Dungannon collieries : this may therefore be classed as incomplete relative to the object ; but as Newry is a place of considerable trade, finishing it so far has a merit. The great design was to furnish Dublin with Irish coals, which was probably feasible ; for the seams of coals in those collieries are asserted to be of such a thickness and goodness, as prove them more than equal to the consumption of half a dozen such cities as Dublin. But two great difficulties were to be overcome : first, to make the navigation such that all land-carriage might be saved, which was properly a public work ; and secondly, to work the collieries, which was properly private business ; but, from the utter deficiency of capital in the hands of the individuals concerned, could never have been done without public assistance. To get over these difficulties, parliament went very eagerly into the business. They granted so liberally to the canal, that I think it has been finished to within two or three miles of the collieries. At the same time a private company was formed for working the mines, to whom considerable grants were made, to enable them to proceed. The property in the works changed hands several times : among others, the late archbishop of Tuam (Ryder) was deeply concerned in them, and entered with great spirit into the design ; but what with the impositions of the people employed, the loss of some that were able and honest, the ignorance of others, and the jobbing spirit of some proprietors, parliament, after granting enormous sums both to the canal and collieries, had the mortification, instead of seeing coals come to Dublin, to see nothing but gold sent from Dublin, to do that which fate seemed determined should never be done, and so in despair abandoned the design to the navigation-board, to see if their lesser exertions would effect what the mightier ones had failed in. A Mr. Ducate, an

Italian engineer and very ingenious architect, has had for a few years the superintendence of the works; but the temper of the nation has been so soured by disappointments, that he has not the support which he thinks necessary to do any thing effectual.

The importance of the object will appear from this circumstance: that upon average of seven years, from 1764 to 1770, the import of coals amounted to 180,113 tons per annum, and in the next seven years, from 1771 to 1777, to 204,566 tons.

From whence it appears, that not only the quantity itself is great, but that it is a very rising import, owing to the increase of Dublin, which has enlarged with the increasing prosperity of the kingdom.

The little effect of all attempts to supply Dublin with Irish coals, is seen by the bounties paid for that purpose, amounting to no more, for the last seven years, than from one to two hundred pounds a year. In the years 1776 and 1777 they were so little as eighty-six pounds.

Before I entirely dismiss this undertaking, I cannot but remark, that nothing can more clearly prove the amazing want of capital in Ireland, than the present state of these works. The navigation is completed, except two or three miles. I will venture to assert that parliament would grant the money for finishing it without hesitation, provided any men of undoubted substance would engage to work the collieries at their own expence; we may therefore assert there is water-carriage from some of the finest seams of coals in the world, and at a very slight depth, directly into the heart of the second market in the British dominions, with the advantage of a parliamentary bounty per chaldron on their import to Dublin; yet, with all these advantages, nobody has capital enough to undertake the work. This fact seems also to call for another observation. I remember in the English House of Commons, in the sessions of 1777 and 1778, when the friends of the Irish bills urged, that the want
of

of capital in Ireland was such that she could never rival the manufactures of Great Britain, it was replied, that English capitals would go over to do it for them ; but what I have just recited proves that this remark is perfectly unfounded. If capitals were so readily moved from one country to another, the Drumglass collieries would have attracted them, especially as an interest for ever is to be purchased in them ; but the fact is, that removable capitals are in the hands of men who have been educated, and perhaps have made them locally, in some trade or undertaking which they will not venture to move. Prejudice and habit govern mankind as much even as their interest ; so that no apprehension can be so little founded as that of a country losing the capital she has made, by transferring it to another for greater seeming advantages in trade.

The grand canal, as it is ridiculously termed, was another inland navigation which has cost the public still greater sums. The design, as the maps of Ireland shew, was to form a communication, by water, between Dublin and the river Shannon, by this cut, most of the way through the immense bog of Allen. The former plan, of bringing coals to Dublin, was a very wise one ; but this of the grand canal had scarcely any object that seemed to call for such an exertion. If the country is examined through which the intended canal was to pass, and also that through which the Shannon runs, it will be found, considering its extent, to be the least productive for the Dublin market of the whole kingdom. Examine Leitrim, Roscommon, Longford, Galway, Clare, Limerick, and those parts of West Meath and King's County which the line of the canal and the Shannon lead through : there are scarcely any commodities in them for Dublin : nay the present bounty on the inland carriage of corn proves to a demonstration that the quantity raised in all these counties for that market is contemptible. What other products are there ? Raw wool takes another direction ; it goes at present from Roscommon to Cork. Manufactures in that line are very insignificant : there are some at Galway, but the ports of Limerick and Galway are perfectly sufficient for the small exportation of them. There remains
nothing

nothing but turf; and who at Dublin would burn that, while Whitehaven coals are at the present price?

Most of the inland navigations in England are carried on, or have been executed, with private funds, and the interest paid by the tolls. One strong reason for this mode, is the prevention of unnecessary and idle schemes. The manufactures must be wrought, or the products raised, and feel the clog of an expensive carriage, before private persons will subscribe their money towards a cheaper conveyance; in which case the very application to parliament is generally proof sufficient that a canal ought to be cut. Have something to carry, before you seek the means of carriage. I will venture to say, that if the grand canal was entirely completed, the navigation of it, including whatever the country towns took from Dublin, would prove of such a beggarly account, that it would then remain a greater monument of folly, if possible, than at present. Some gentlemen I have talked with on this subject have replied, "It is a job: it was meant as a job; you are not to consider it as a canal of trade, but as a canal for public money." But even this, though advanced in Ireland, is not upon principle. I answer, that something has been done. Fourteen miles, with numbers of locks, quays, bridges, &c. &c. are absolutely finished, though only for the benefit of eels and skaiting. Why throw this money away? Half what these fourteen miles have cost, would have finished the Newry canal, and perfected the Dungannon collieries. Admit your argument of the job. I feel its weight; I see its force; but that does not account for the sums actually expended. Might not the same persons have plundered the public to the same amount in executing some works of real utility, from which something else might have resulted than disgrace and ignominy to the nation?

As to the other navigations, there is in general this objection to be made to them all: however necessary they might be, they are useless for want of being completed: three-fourths are only begun. The gentlemen

men of the neighbourhood of them have had interest enough in the navigation board to get a part only voted; and from the variety of undertakings going on at the same time, all are, for the same reason, incomplete. The advantage to the public has been more trifling from all, than from a single one finished. Sorry I am to say, that a history of public works in Ireland would be a history of jobs, which have been, and will prove of much worse consequence than they may at first appear. They have given a considerable check to allowing grants of money. Administration, seeing the uses to which it has been applied, has viewed these misapplications, as they are esteemed, of the public money with a very jealous eye. They have been greatly curtailed; until another very questionable measure, the bounty on the inland carriage of corn to Dublin, demanded so much, as to leave nothing for jobs of a different sort. That measure may be repealed, and the money applied to it will be at the disposal of parliament, either for the common purpose of government, or some national improvement of a more decisive nature. The latter may, after so many instances, be rejected, for fear it should become a job. How melancholy a consideration is it, that in a kingdom which, from various causes, had been so fortunate as to see a great portion of public treasure annually voted for public purposes, that same treasure should be so abominably misapplied, and pocketed by individuals, as to bring a ridicule and reproach upon the very idea of such grants. There is such a want of public spirit, of candour, and of care for the interests of posterity in such a conduct, that it cannot be branded with an expression too harsh, or condemned in terms too pointed; nor does it less deserve our detestation, should it be found to flow from political and secret motives, which aim at burthening the public revenues to render private factions of more importance.

The coal-mines nearest the grand canal are principally at Castlecomer, the estate of lord Wandcosford, who is said to clear ten thousand pounds annually by them. If the grand canal were finished to the Barrow, he would probably make much more, for that would open a communication

with Dublin ; but hills interpose, which must be cut through for that purpose. The carriers at present pay five-pence per hundred weight, and sell them at Dublin for one shilling and eight-pence per hundred, after carrying them eighty English miles.

The good effect of a short canal, cut near the town of Limerick, is very sensibly felt ; for sea-coal, which was formerly the fuel of the inhabitants, is so disused, that its price is much lowered ; turf, the material, and I may say, the manufacture of which is all their own, now supplying their hearths. If the merchants of Limerick would cut canals opposite to the shallows in the river Shannon, it would be rendered navigable to Carrick, in the county of Leitrim, a space of ninety miles, which would open a conveyance for grain, timber, iron, coals, turf, &c. and must at length turn the current of trade in their favour.

A navigation of near two hundred English miles in length, by communicating with the canal leading from Dublin through the bog of Allen, might be accomplished at a trivial expence, considering its utility, and the sums already lavished almost to no purpose. Such a navigation would in time make Limerick one of the most considerable places for importation in the kingdom. The large tracts of country on both sides the river cannot fail of creating a great demand. The same cause may operate upon the exports, by facilitating the conveyance of beef, mutton, butter, hides, tallow, grain, &c. to a sea-port. Though the town is sixty miles from the sea, ships of five hundred tons come up to the quays.

Ireland is at least eight hundred miles in circumference, and contains nearly two thousand square miles ; and yet it is worthy of observation, that the inland parts are not, one place with another, above twenty-four miles from the sea. What a noble field for canals and improvement ! I will venture to aver that the money already granted and expended, if properly laid out, would have intersected the country with
canals ;

canals; and an inland navigation might have been established throughout the internal part of the whole country, except three or four counties, to the great advantage of the land-owners and manufacturers already established, the probable settlement of many new ones, and the encouragement and improvement of agriculture through every part of the kingdom.

I shall conclude with stating, from the Journals, the sums granted by the Irish parliament for completing these canals and working the collieries; which will shew that the fault did not lie in the employers, but in the employed, from 1753 to 1770 inclusive.

	£.
Newry river navigation - - -	9,000
Drumglafs colliery and navigation - -	112,218
Dromreagh ditto - - -	3,000
Lagan ditto - - -	40,304
Dungarvon aqueduct - - -	1,300
Shannon navigation - - -	31,500
Grand canal - - -	73,646
Blackwater - - -	11,000
Barrow river - - -	10,500
Lee river navigation - - -	2,000
Minsterkenry collieries - - -	2,000

Several other rivers have likewise been deepened and cut to improve the inland navigation of the country. The above sums, however, with other monies granted by the navigation board, ought to have completed the works entirely.

The following sums were granted by the navigation board only, from 1768 to 1771:

	£.
Newry canal - - -	2,434
Drumglafs - - -	5,566

Y y 2

Barrow

				£
Barrow	-	-	-	3,100
Shannon	-	-	-	7,660
Grand canal	-	-	-	4,585
Boyne	-	-	-	9,507
Fergus	-	-	-	85

The total of the money paid out of the revenues for inland navigations, collieries, docks, &c. amounts to the enormous sum of 379,388 l.

It is not to be wondered at, that, in 1771, after the grand canal had been so long in hand, and after such great sums had been expended on it, though so little was completed, and every thing nearly at a stand, the management of it should be taken from persons so unfit for such a work, and committed to others. This alteration, however, has not succeeded to the wishes of the nation, or promoted the interest of the employers.

NORTH AMERICA.

THE United States of America, now in their infancy as a nation, cannot be expected as yet to afford many examples of improvement by canals. That country, if I may be allowed the metaphor, resembles a young man just out of his apprenticeship, and set up in business for himself, whose whole time, care, abilities, and exertions must be employed to maintain his credit and situation, without his being able for some time to afford to lay by any thing for improvements. In like manner America, but lately disengaged from her dependency on the mother country, and after a war for her freedom, which has deranged, and for a time ruined her finances, cannot be supposed capable of improving the advantages which nature has bestowed on her. She possesses an immense sea-coast, the whole length of which is happily situated for trade, and abounds with excellent bays and harbours, while the internal

parts

parts of the country are intersected with the noblest rivers, many of which are navigable for ships of the largest burthen for some hundreds of miles within land, and even to the very door of the planters ; so that but little art or improvement by canals are wanting to render that country the most convenient for commerce and inland navigation of any on the face of the globe.

But though America is yet only in her infancy in point of independence as a nation, she has experienced the happy effects of improving trade, by the encouragement and bounty of a benevolent parent. Her noble coasts, bays, rivers, and products, have invited, for half a century, the maritime countries of Europe to engage in her trade ; and the West India islands belonging to the European states have by her been chiefly supplied with the necessaries of life, and enabled to send home their produce. The profits of her trade, which formerly used to be drawn to the mother-country, now centre in her states ; and it may with truth be said, that no part of the world is so well watered with springs, rivulets, rivers, and lakes, as the territory of the United States. By means of these various streams, and collections of waters, the whole country is divided into islands and peninsulas. The United States, and indeed all parts of North America, seem to have been formed by nature for the most intimate union. The facilities of navigation render the communication between the ports of Georgia and New Hampshire infinitely more expeditious and practicable than between those of Provence and Picardy, in France ; Cornwall and Caithness, in Great Britain ; or Galicia and Catalonia, in Spain. The canals proposed at South Key, Susquehannah, and Delaware, will open a communication from the Carolinas to the western counties of Pennsylvania and New-York. The improvements of the Patomak will give a passage from the southern states to the western parts of Virginia, Maryland, Pennsylvania, and even to the lakes. From Detroit, on lake Erie, to Alexandria, on the Patomak, six hundred and seven miles, there are but two carrying places, which together do not exceed the distance of forty miles.

The

The canals now cutting to the Delaware and Chesapeake will open a communication from South Carolina to New Jersey, Delaware, the most populous parts of Pennsylvania, and the midland counties of New-York. These important works have been surveyed; and it is computed that they may be completed for two hundred thousand guineas. The United States of America will hereafter be converted into a cluster of large and fertile islands, communicating with each other with ease and little expence, and in many instances without the uncertainty or danger of the sea.

The vast extent of sea-coast which spreads before these confederated states; the number of excellent harbours and sea-port towns; the numerous creeks and immense bays which indent the coast; and the rivers, lakes, and canals which peninsulate the whole country, added to the agricultural advantages and improvements, give this part of the world superior advantages for trade. Add to these their prospects from the fur trade of Canada, the vast settlements which are making at Pittsburgh, and in other parts in the neighbourhood of Canada, the advantages of inland navigation by means of the lakes, the northern branches of the Ohio, the Patomak, the Susquehannah and the Hudson, with many other circumstances, depending not only on situation, but likewise on the climate, &c. which must necessarily in a few years give them a large share of the fur trade.

On the north side of the mountains in Orange county, in the state of New-York, lies a very valuable tract, called the Drowned Lands, containing about fifty thousand acres. The waters which descend from the surrounding hills being but slowly discharged by the river issuing from them, cover these vast meadows every winter, and render them extremely fertile; but they expose the inhabitants to intermittents. The Wall-kill river, which passes through this extensive and amphibious tract, and empties itself into Hudson's river, is in the spring stored with very large eels in the greatest plenty. The bottom of this river is a broken rock,
and,

and, from as accurate a survey as possible, it is supposed that two thousand pounds would be the utmost sum of money wanted to deepen the channel, so as to let off all the waters from the meadows, and thereby redeem from the floods a large tract of rich land, for grass, hemp, and Indian corn. In 1789 the state had it in contemplation to raise this sum, and carry into execution a plan so evidently conducive to the general good and profit of the community.

In Pennsylvania the river Swetara, which falls into the Susquehanna, from the north-east, is navigable fifteen miles. It is now in contemplation to cut a canal about twenty miles from the river Swetara to the river Tulpehocken, a branch of the Schuylkill. Should this be effected, a passage would be open to Philadelphia from the Juniatta, the Tyoga, and the east and west branches of the Susquehanna, which water at least 15,000,000 acres. From this junction, the general course of the river is about south-east, until it falls into the head of the Chesapeake bay, just below Havre-de-Grace. It is about a mile wide at its mouth, and is navigable for sea-vessels only about twenty miles, on account of its rapids. The banks of this river are very romantic, particularly where it passes through the mountains. This passage has every appearance of having been forced by the pressure of the water, or burst open by some convulsion of nature.

Besides the aforesaid channels between the western waters and the Atlantic, there are two others to which the Pennsylvanians are turning their attention: one from Presqu'isle, on lake Erie, to Le Bœuf, down the Allegany river to Kiskiminitas; then up the Kiskiminitas, and from thence by a small portage to the Juniatta, which falls into the Susquehanna: the other from lake Ontario to the east branch of the Delaware, and down that river to Philadelphia. Both these are said to be very practicable at no very great expence, and considering the enterprising spirit of the merchants of that city, whose object is concentrated in promoting

promoting their commerce and trade, it may be reasonably expected that both these communications will be opened and improved.

There is still another communication equally practicable with either of the others, and which has not escaped notice: this is between the southern branch of the Tyoga and a branch of the Allegany; the head waters of which are but a short distance from each other. The Seneca Indians have informed the Pennsylvanians that they can walk four times a day from the *boatable* waters of the Ohio to those of the Tyoga, at the place now mentioned; and between the Susquehannah, just before it crosses into Pennsylvania the first time, and the Delaware, is a portage of only twelve miles.

Several improvements are carrying on in the state of Virginia; to give an account of which it will be necessary to survey those rivers that will be the objects of operation: and first, Patomak river. This river is seven miles and a half wide at its mouth, four and a half at Nomony bay, three at Aquio, one and a half at Hallooing-point, one and a quarter at Alexandria, opposite to which, in the state of Maryland, the congress have resolved to build their new city; and every state is assessed its respective quota for that purpose. During the time of building it, the congress have resolved to sit in the city of Philadelphia till the year 1800, when the new city is to be named, and the congress will remove to it as the seat of government; the central situation of which, and the noble river it is upon, must command a vast trade. Its soundings are seven fathoms at the mouth, five at St. George's Island, four and a half at Lower Matchodic, three at Swan's Point and up to Alexandria; whence there is ten feet water to the falls, which are thirteen miles above Alexandria.

The distance from the Capes of Virginia to the termination of the tide-way in this river Patomak, is above three hundred miles; and the river is navigable for ships of the greatest burthen nearly to that place:

from thence it is obstructed by four considerable falls, and runs through a vast tract of inhabited country towards its source. These falls are, 1st, The little falls, three miles above tide-water ; in which distance is a fall of thirty-six feet. 2dly, The great falls, six miles higher, where is a fall of seventy-six feet in one mile and a quarter. 3dly, The Seneca falls, six miles above the former, which form short, irregular rapids, with a fall of about ten feet. And 4thly, the Shenandoah falls sixty miles from the Seneca, where is a fall of about thirty feet in three miles ; from which last Fort Cumberland is about one hundred and twenty miles distant. The obstructions which are opposed to the navigation above and between these falls are of little consequence.

Early in the year 1785 the legislatures of Virginia and Maryland passed acts to encourage opening the navigation of this river. It was estimated that the expence of the canals and other works would amount to fifty thousand pounds sterling ; and ten years was allowed for their completion. At present the president and directors of the incorporated company suppose that forty-five thousand pounds will be sufficient for the undertaking, and that it will be accomplished in a shorter time than was estimated. Their calculations are founded on the progress already made, and the summary mode lately adopted for enforcing the collection of the dividends as the money may become necessary. On each share of 100 l. the payment of only 40 l. has yet been demanded.

According to the opinion of the president and directors locks will be necessary at only two places ; the great and little falls ; six at the former, and three at the latter. At the latter nothing has yet been attempted. At the great falls, where the difficulties were judged by many to be insurmountable, the work is nearly completed, except sinking the lock-seats and inserting the frames. At the Seneca falls the laborious part of the business is entirely accomplished, by removing the obstacles and graduating the descent ; so that nothing remains but to finish the chan-

nel for this gentle current in a workman-like manner. At the Shenandoah, where the river breaks through the Blue Ridge Mountains, though a prodigious quantity of labour has been bestowed, yet much is still to be done before the passage will be completed. Such a progress has been made, however, that it was expected, if the summer had not proved uncommonly rainy, and the river uncommonly high, an avenue for a partial navigation would have been opened by the first of January, 1789, from Fort Cumberland to the great falls, which are within nine miles of a shipping port.

As soon as the proprietors shall begin to receive toll, they will doubtless find an ample compensation for their pecuniary advances. By an estimate made many years ago, it was calculated that the amount, in the commencement, would be at the rate of 11,875 l. Virginia currency, per annum. The toll must every year become more productive, as the quantity of articles for exportation will be augmented in a rapid proportion with the increase of population and the extension of settlements. In the mean time the effect will be immediately seen in the agriculture of the interior country; for the multitude of horses now employed in carrying its produce to market, will then be used for the purposes of tillage. But in order to form just conceptions of the utility of this inland navigation, it will be requisite to notice the long rivers which fall into the Patomak, and even the geographical position of the western waters.

The Shenandoah, which disembogues just above the Blue Mountains, may, according to report, be made navigable, at a trifling expence, more than a hundred and fifty miles from its confluence with the Patomak, and will receive and convey the produce of the richest part of the state. The south branch, still higher, is navigable in its present condition nearly, or quite, one hundred miles, through extremely fertile lands. Between these, on the Virginia side, are several small rivers, that may with facility be improved, so as to afford a passage for boats. On the
Maryland

Maryland side are the Monocacy, Antietam, and Conegocheague; some of which pass through the state of Maryland, and have their sources in Pennsylvania.

From Fort Cumberland (or Will's Creek) one or two good waggon roads may be made, by which the distance will be about five and thirty miles to the Yohogany, a large and navigable branch of the Monongahela; which last forms a junction with the Allegany at Fort Pitt, from whence the river takes the name of the Ohio, until that also loses its current and name in the Mississippi.

But by passing farther up the Patomak than Fort Cumberland, which may very easily be done, a portage by a good waggon road to the Cheat river, another branch of the Monongahela, may be obtained, through a space which some say is about twenty-five miles.

When we have arrived at either of these western waters, the navigation through that immense country is opened in a thousand directions, and to the lakes in several places by portages of less than ten miles, and by one portage of one mile only.

Notwithstanding it was sneeringly said by some foreigners, at the beginning of this undertaking, that the Americans were fond of engaging in splendid projects, which they could never accomplish; yet it is hoped the success of this first essay towards improving their inland navigation will, in some degree, rescue them from the reproach intended to have been fixed upon their national character by the unmerited imputation.

The great Kanaway is a river of considerable note. The principal obstacle to its navigation begins at what are called the Great Falls, ninety miles above the mouth, below which are only five or six rapids, and these passable, with some difficulty, even at low water. From the falls to the mouth of Green-briar river is one hundred miles; and thence to

the lead mines is one hundred and twenty. It is two hundred and eighty yards wide at its mouth.

The Little Kanhaway is one hundred and fifty yards wide at the mouth ; it affords a navigation of ten miles only. Perhaps its northern branch, called Junius Creek, which interlocks with the western waters of Monongahela, may one day admit a shorter passage from the latter into the Ohio.

In the state of North Carolina is a place called Dismal Swamp, which spreads over the whole tract of country which lies between Pamlico and Albemarle sounds, and needs no other description than is conveyed by its name. There is another large swamp, north of Edenton, which lies partly in this state and partly in Virginia.

This swamp is owned by two companies ; the Virginia company, of which General Washington is a member, holds a hundred thousand acres, and the North Carolina company about forty thousand acres. It is in contemplation to cut a canal through this swamp, from the head of Pasquetank to the head of Elizabeth river, twelve or fourteen miles in length, which will drain this at present useless ground, and convert it to be the best in the state.

These are the principal particulars which at present can be given of this extensive country with respect to its improvements by canals and inland navigation. A great number of other cuts have been planned, which will make that country in a few years not inferior to the best cultivated and improved states in the old world.

I shall conclude my observations on North America with the following extract from the Journals of Mr. Elkanah Watson, a gentleman who has travelled much both in Europe and America.

“ When

“ When the extent of America is considered as boldly fronting the old world—blessed with every climate—capable of every production—abounding with the best harbours and rivers on the globe, and already overspread with three millions of souls, mostly descendants of Englishmen—inheriting all their ancient enthusiasm for liberty, and enterprising almost to a fault—what may be expected from such a people in such a country?—The partial hand of nature has laid off America upon a much larger scale than any other part of the world. Hills in America are mountains in Europe, brooks are rivers, and ponds are swelled into lakes. In short, the map of the world cannot exhibit a country uniting so many natural advantages, so pleasingly diversified, and that offers such abundant and easy resources to agriculture and commerce.

“ In contemplating future America, the mind is lost in the din of cities—in harbours and rivers clouded with sails—and in the immensity of her population. Admitting her present population to be three millions, and calculating her progressive increase to continue doubling once in twenty years, as has hitherto been the case, at the end of one hundred years there will be ninety-six millions of souls in United America; which is two-thirds as many as there are at present in Europe: and when we consider the probable acquisition of people by foreign emigrations, and that the interior and unsettled parts of America are amply sufficient to provide for this number, the presumption is strong that this estimation will not differ materially from the event. Europe is already aware of the rising importance of America, and begins to look forward with anxiety to her West India islands, which are the natural legacy of this continent, and will doubtless be claimed as such when America shall have arrived at an age which will enable her to maintain her right.

“ The northern and southern states differ widely in their customs, climate, produce, and in the general face of the country. The middle states preserve a medium in all these respects; they are neither so level and hot as the south states, nor so hilly and cold as the north and eastern.

The inhabitants of the north are hardy, industrious, frugal, and, in general, well informed ; those of the south are more effeminate, indolent, and imperious. The fisheries and commerce are the finews of the north ; tobacco, rice, and indigo, of the south. The northern states are commodiously situated for trade and manufactures ; the southern to furnish provisions and raw materials ; and the probability is, that the southern states will one day be supplied with northern manufactures instead of European, and make their remittances in provisions and raw materials."

SOUTH AMERICA.

WE have so little knowledge of South America, that it is impossible to say any thing, with certainty, relative to any improvements by canals or inland navigations carried on in that remote part of the world. The care with which the Spaniards endeavour to keep the state of this country, its productions, and immense wealth, a secret from the rest of Europe, prevents us from knowing what works of this kind may have been projected or undertaken : but the natural indolence of its masters, and the laziness of the natives, who have no other prospect than perpetual slavery, render it extremely improbable that any such improvements should be attempted there.

I have mentioned, when treating of the canals of Spain, the project for cutting a canal through the isthmus of Darien, from Panama to Nombre de Dios ; to which I have now to add, that, in the *Collection of Voyages*, vol. iv. mention is made of a great canal, cut to draw down the lake of Mexico, which employed four hundred and seventy-one thousand one hundred and fifty-four men.

Having thus given an historical account of the canals that have been completed or projected in this and other countries, as far as I have been enabled by my own knowledge, or the relations of historians and travellers,

lers, I shall in the next chapter add some practical observations and directions, for the use of persons employed in conducting works of this kind.

C H A P. XIV.

Some practical Observations relative to the Places proper for Canals—the Supply of Water—the most eligible Levels—the Nature of the Ground to be cut through—and the Expence and Mode of Execution.—Description of a Lock, a Tunnel, and an Aqueduct.

IN the foregoing sheets I have taken several opportunities to point out and enforce the great and numerous advantages attending canal or inland navigation: I shall not here again enlarge on that subject, but conclude the work with some practical observations, which will be found particularly useful to persons about to engage in undertakings of this kind; according to the old adage, “That a good beginning makes a good conclusion.” These observations I shall reduce to the six following heads:

- 1st, The places to be benefited in point of trade.
- 2dly, The supply of water.
- 3dly, The most eligible levels.
- 4thly, The nature of the ground to be cut through.
- 5thly, The expence of execution.
- 6thly, The mode of execution.

1st. *Places to be benefited in point of trade.*

Trade being the grand source from which adventurers in canal schemes expect to derive their great profits, such towns, places, &c. must be included in the line of a canal, to which the safe, expeditious, and easy conveyance of merchandize, and consequent enlargement of commerce,

will be of moment. These can be fixed upon only by an accurate survey and knowledge of the country through which the canal is intended to pass.

2dly. *The supply of water.*

It is almost needless to mention the absolute necessity of a supply of water for a canal, which must be in requisite quantities in the summit, or reservoirs, which may be supplied by the neighbouring springs; or, if these fail, water must be thrown up by engines from a lower level.

RESERVOIRS are large bodies of water collected together for the use of such parts of the canal as are likely to be deficient; into which it is let by sluices, when and where wanted.

The quantity of water requisite for the use of a canal depends in a great measure upon the quantity of trade carried on. A lock full of water must be lost every time a boat passes through, which, in a lock whose length in the chamber is 75 feet, breadth 7 feet, and lift 6 feet, will be 125 cubic yards of water; which quantity, multiplied by the number of boats likely to pass through the summit lock, will give an idea of the waste of water. Allowance also must be made for exhalation and accidents.

3dly. *The most eligible levels.*

The most eligible LEVEL is certainly that which has the least fall and the fewest obstructions, and is best adapted to the face of the country.

4thly. *The nature of the ground to be cut through.*

The SOIL most favourable for a canal is clay; the most unfavourable, sand. As soils approach more or less to the quality of clay or sand, in such proportion are they to be preferred for holding water.

5thly.

5thly. *The expence of execution.*

Of this little can be said, as it entirely depends on the extent, the several works, &c. which can be accurately known only by an actual survey and estimate; the total of which will of course be considered previous to undertaking works of such magnitude. It may be proper to observe, generally, that many locks, bridges, or aqueducts, much tunneling, unfavourable soil, &c. will of necessity incur great expences.

Lastly. *The mode of execution.*

The foregoing particulars having been attended to, it becomes necessary to enumerate the several works, useful and necessary, in the execution of a canal.

For the passing and repassing of boats, various expedients have been used; but experience confirms the use of locks, when it becomes necessary, by artificial means, to raise or let down boats from one level to another.

A LOCK (technically a *pound lock*) is a large basin, or, more properly, a long square cistern, placed lengthways in a river or canal, inclosed by upper and lower gates. The lock should be lined with walls of strong masonry on each side, and at the bottom; or if of wood, stout oak piles should be used, shod with iron, and lined with two inch and half or three inch oak plank, with a floor of the same materials, laid on oak sleepers, dove-tailed and spiked into the upright piles.

The use, or *locking down*, is thus managed: The lock being full to the level of the upper water, the gates are then shut, including the boat to be lowered. The water in the lock is drawn off, in part first, by means of the paddles in the gates, and completely by the gates being

opened; when the boat, being upon a level with the lower water, is able to proceed upon its passage. For ascending, or *locking up*, the boat being in the lock, the lower gates are shut: the lock is then filled by the upper water, first by the sluices, and finally by the gates being opened: thus the vessel is on a level with the upper water, and may immediately proceed. This operation takes but little time; the whole will generally be completed in five minutes. As the gates are strained in proportion to the depth of water supported, when the perpendicular height of the water is twelve or thirteen feet, more locks than one become absolutely necessary. Thus if the fall of water be seventeen feet, two locks are required, each having eight feet six inches fall; and if the fall be twenty-six feet, three locks are necessary, and so in proportion, few locks having less than six feet, or more than ten feet fall.

The side-walls of a lock must be of the greatest strength, whether of masonry or timber; and where the natural foundation is bad, especial care must be taken. Land-ties should be used, in order to resist the great pressure of the earth from behind. These may be further strengthened, if of masonry, by making the sides of the lock of a circular form; the walls also should be well backed with stiff clay, as well to prevent the wasting of the water, as the works being secretly undermined.

DESCRIPTION of Plate I. which shews the PLAN, &c. of a LOCK for a CANAL.

- A. The upper water of the canal.
- B. Lower ditto.
- C. Chamber of the lock.
- D. The platform on which the upper gates are hung.
- E. The lower ditto, shewing the manner of construction.
- F. Sluices through which the water passes into the chamber, to raise it equal with the upper level.
- G. Paddles

G. Paddles in the gates, to reduce the water to the lower level. There is a *chain-bar*, run with lead in a course of stone, set at water level.

A TUNNEL is a perforation, for the passage of boats through a hill, for some or all of the following reasons : To save the purchase of land in going a long way round, or to save the labour, in cutting a canal the length required in going that round, or when, in some instances, a level cannot be found.

The manner of cutting a tunnel through a hill or mountain varies according to the quality of the soil ; whether stone, loose stones, earth, ores of different kinds, chalk, &c. In either case the progress is very slow and expensive. From three to seven guineas per yard, forward, have been paid for labour only.

The tunnel at Sapperton is rock-stone, consequently it was obliged to be blown up, piece-meal, by gunpowder. It was intended to have formed an arch, over head, out of the solid rock, and to have avoided turning one by hand ; but this not being practicable, it became therefore necessary to work an arch of stone on centres, to prevent the loose stone falling in. The length of this tunnel is about two miles and three quarters : it has air-holes, or vents, at various places, of different magnitudes ; some of the openings being left, which were first made to take up the refuse, or fragment stone.

The celebrated tunnel through Harecastle-hill, Staffordshire, was cut under the direction of the ingenious Mr. Brindley. As the soil was chiefly loose stone, he caused the bed of the canal to be rammed with well-tempered stiff clay, a foot thick, and turned an arch above with bricks ; taking care to have the spandrells worked close every yard, as the arch proceeded ; which was also pinned up to the top at the same distances. These precautions have had the desired effect, no accident

having happened since it was finished ; nor has the water oozed through, to the detriment of the canal, but all the purposes expected have been well answered.

An AQUEDUCT is a structure to convey a canal over rivers, morasses, or low grounds. I have already described those over the river Irwell, and across the Sale-moor, constructed by the late Mr. Brindley for the duke of Bridgewater : but the largest in Great Britain (if not in Europe) is that lately finished by Mr. Whitworth, the engineer to the Forth and Clyde navigation in Scotland, over the river Kelvin, which consists of four arches, and carries the canal over a valley sixty-five feet deep, and four hundred and twenty feet in length ; exhibiting a grand effort of ingenuity and labour. In the course of this canal, for a considerable way, there is an embankment twenty feet high : the water is sixteen feet deep. Two miles of the canal is cut through a deep morass. At Kirkintilloch the canal is carried over Loggie water on an aqueduct arch of ninety feet span. This arch was thrown over in three stretches, having only one centre of thirty feet, which was shifted on small rollers from one stretch to another ; a mode ingenious and novel for an arch of this size. The joinings are fair, and as equal as any other part of the structure ; which is admitted to be a piece of very fine masonry.

To supply this canal with water was a very arduous task. There is one reservoir of fifty acres, twenty-four feet deep ; and another of seventy acres, twenty-two feet deep, in which many rivers and springs terminate. These, it is expected, will afford a sufficient supply of water at all times.

Plate II. shews a design for an aqueduct which crosses a river the width of the three centre arches ; and, to occupy the remaining space usefully, the extreme arches are converted into warehouses.

a. The

a. The river. b. The canal. c. Towing-path. d. Warehouses.
e. A bed (technically a *punn*) of clay, to prevent the water weeping through the arches. f. The canal continued by embankment.

In the line of a canal many BRIDGES are generally necessary. We give a design for one suitable for a public road, and constructed on the most economical principles.

Plate III. *Elevation, &c. of a Bridge.*

a. The canal. b. Plan of the foundation. c. Towing-path under the bridge. d. Plan of the superstructure.

Also, a canal in its course often divides lands with which some communication is necessary for the purposes of husbandry. The easiest method is shewn on plate IV. This is called *an accommodation bridge*. It hangs by large hooks and eyes, or hinges, and is worked up and down with ease, by means of the balance poles. This view also shews a towing-path gate, which is used for dividing grounds, and is hung so as always to fall to.

In whatever part of a canal business is intended to be carried on, there will require to be a wharf, with sufficient space for loading and unloading goods, with warehouses, weighing-engines, and cranes, for the use of the trade; and where this is extensive, a BASIN is requisite, to accommodate boats which wait to discharge their lading, without interrupting the regular navigation on the canal.

The regular *drainage* of lands is often interrupted by the line of a canal; to remedy which the water-course is continued by a CULVERT, which is a circular drain continued under the bed of the canal, coated with clay. As water cannot always be supplied in due quantities for the use of a canal from the natural flow of rivers, &c. it becomes necessary

sary to supply this deficiency from rivers, ponds, &c. on a lower level, by means of engines; and for this purpose, the most powerful is the steam-engine.

Having now enumerated the several articles of most importance to be known, I shall beg leave to conclude with one word of advice of general use; which is, that all works for the use of canals should in all cases be built in the most substantial and workman-like manner possible, and of the best materials and constructions; for in so doing, much future expence and inconvenience will be avoided in *repair*, perhaps in *rebuilding*. Were it necessary, many recent misfortunes might be mentioned to this purpose; but these would appear invidious. In all cases contracts should be made full and explicit with respectable persons, and sufficient prices allowed. These will most likely insure the several works being properly performed; not that it is prudent to rely entirely on them: the workmen should be looked after, and the materials well examined in the progress of the works, by careful and able inspectors.

P O S T S C R I P T.

SINCE this work went to press several new canals have been planned, and acts of parliament obtained in consequence; and many more are now under consideration, which being at present in a state of uncertainty, cannot now be described. Of those which have been rendered certain, by acts being procured, the following is a concise account:

In 1791 an act passed for making, cutting, and maintaining a navigable canal from the city of Hereford, by the town of Ledbury, to the city of Gloucester, with a collateral cut to the town of Newent, in the county of Gloucester, which will open a communication with several very valuable mines of coal, and quarries of lime-stone, and a new and easy channel for trade between not only the city, but the whole county of Hereford, and the several ports of London, Bristol, Liverpool, and Hull; as also with the interior parts of South Wales. This canal is to be forty-two feet wide. The expence is estimated at 75,000 l. with liberty to raise 30,000 l. more, if wanting, to complete the undertaking.

In the same year another act passed for making a navigable canal from Kington, in the county of Hereford, through or near Leominster, into the river Severn, near Stourport-bridge, in the county of Worcester; which will be of the utmost utility in working and vending the coals from those extensive collieries, and lime-stone from the quarries, as well as ores of different kinds. The land to be taken for the purpose of the canal and towing-paths to be twenty-six yards, and in some particular places, and for particular purposes, the breadth may be sixty yards; and the company is empowered to raise, for the purpose of making the canal, wharfs, quays, bridges, &c. &c. the sum of 150,000 l. and if that

is not sufficient, may subscribe or borrow more without applying again to parliament.

In this year also another act passed for making a navigable canal between the Loughborough canal and the town of Leicester. This canal is to commence on the north side of the town of Loughborough, in the county of Leicester, proceed to the town of Leicester, and from thence into the river Soar, at the village of Quorndon. By the same act the river Soar is to be made navigable to its junction with the river Wreake, and to Copington, Thurmaston, and the coal-pits and lime-works of Swannington, Coal Orton, Thringston, Breedon, and Gracedieu, all in the county aforesaid, which will extend the navigation, sale, and consumption of various goods and manufactures, as well as coals and lime, to the ports of Hull, Bristol, and Liverpool, the cities of London, Gloucester, Worcester, and Hereford, and the towns of Birmingham, Wolverhampton, and Manchester, as well as to many other towns and intermediate villages. This canal is to go into the basin or reservoir; and the navigation, or canal which is made from the town of Loughborough, into the river Trent. The breadth of the canal and towing-paths is confined to twenty yards; and the company is impowered to raise 46,000 l. to complete the same; and if that sum is insufficient, they are further impowered to raise 20,000 l. more, or any less sum, if wanting, to finish.

The utility of the canal was so obvious, that in the same year another act was obtained for making a canal from Melton Mowbray, in the county of Leicester, to join the aforesaid canal from Leicester to Loughborough, which must be equally beneficial, by conveying the produce of the mines and manufactures with which that part of the country abounds, to the cities, sea-ports, and towns before-mentioned. The breadth of the canal, towing-paths included, is limited to twenty yards; and the expence is estimated at 25,000 l.

In

In this year, likewise, another act was obtained for making a navigable canal from Manchester, by the village of Little Lever; where one branch is to lead to the town of Bolton, and another branch to the town of Bury; which latter is to be continued to Weddell Brook, all in the county of Lancafter. The town of Manchester having experienced an amazing increase of trade since the Duke of Bridgewater's first scheme of canals was carried into execution, it is not to be wondered at that it should promote and set forward the above: indeed it is a matter of surprise to numbers in the mercantile line that it was not begun sooner, especially as the whole country is one continued mine of coal, metals and minerals, as well as manufactures. The breadth of this canal, and towing-paths, is not to exceed twenty-six yards. The sum of money allowed to complete this undertaking is 47,700 l. but should that be found insufficient, 20,000 l. more may be raised, either by subscription or mortgage.

In the same year another act passed for cutting a canal from near the town of Birmingham, to communicate with the Severn near the city of Worcester, at a place called Diglis; which canal will have the additional advantage of a nearer carriage to Bristol, Worcester, and Gloucester, from Birmingham. That town having experienced the greatest benefit to its trade by means of canals, with which it is surrounded, has planned this new one, which bids fair to exceed all the rest in point of convenience and advantage.

A
T A B L E
O F
C A N A L S I N E N G L A N D.

		Length.			Rise.		Fall.	
		M.	F.	Ch.	Ft.	Is.	Ft.	Is.
Severn and Thames Canal.	From Stroud to Sapperton Tunnel -	7	3	0	24	1 3	0	0
	From Sapperton Tunnel to Upper Siddington, and the Branch to Cirencester	9	0	8	L.			
	From Upper Siddington to Lechlade -	13	4	9	0	0	130	6
Stroudwater Canal.	Stroud to the River Severn -	8	0	3	0	0	102	0
Birmingham and Fazeley Canal.	From Farmer's Bridge, near Birmingham, to Salford Bridge -	3	0	6	0	0	156	0
	From Salford Bridge to Fazeley -	11	7	9	0	0	90	0
	Collateral Branch to Digbeth -	1	1	3	0	0	38	0
Birmingham extension Canal.	From Rider's Green to Broadwater Fire Engine -	2	4	6	0	0	46	0
Wolverhampton Canal.	Haywood to Junction of Birmingham Canal -	22	4	0	125	0	0	0
	Junction to the River Severn -	24	0	0	0	0	301	0
Birmingham Canal.	Wolverhampton Canal to Summit at Smithwick -	16	7	0	150	8	0	0
	Summit to Birmingham -	5	6	0	0	0	36	0
	A Branch to the Collieries -	4	1	0	0	0	18	0
	Another Branch to ditto -	0	6	5	L.			
Stourbridge Canal.	From the Junction of the Wolverhampton Canal, to ditto of the Dudley Canal	5	0	2	191	3	0	0
	The Branches to Stourbridge and Pensnett	2	1	4	L.			
	From the Wolverhampton Canal to the Reservoir on Pensnett Chace -	6	1	0	191	3	0	0
Dudley Canal and Tunnel.	From Stourbridge to the Branch from the Reservoir -	1	2	5	L.			
	From the Junction with the Stourbridge Canal at Black Delft to Dudley Parish	2	0	4	0	0	75	0
	From Dudley Parish to the Birmingham Canal at Tipton -	2	3	6	0	0	31	0
Duke of Bridgewater's Canal.	Worsley to Manchester and Preston Brook	29	2	0	L.			
	Preston Brook to low Water at Runcorn	0	0	0	0	0	95	0
Canal from the Trent to the Mersey.	Branch to Stockport -	7	4	0	60	0	0	0
	Preston Brook to Harecastle -	30	1	0	326	0	0	0
	Harecastle to the River Trent	63	0	0	0	0	316	0
Coventry Canal.	Staffordshire Canal to Atherstone -	21	0	0	95	0	0	0
	Atherstone to Coventry -	14	4	0	L.			
	Branches to Collieries -	1	4	0				

A TABLE of CANALS in ENGLAND.

		Length.			Rise.		Fall.	
		M.	F.	Ch.	Ft.	Is.	Ft.	Is.
Oxford Canal.	Coventry Canal to Hilmorton	-	20	1 0	L.			
	Hilmorton to Top of Napton Field	-	17	1 5	88	0	0	0
	Top of Napton Field to Claydon	-	8	5 1	L.			
Droitwich Canal.	Claydon to Oxford	-	36	0 7	0	0	204	0
	Droitwich to Severn	-	5	5 0	0	0	56	6
Chesterfield Canal.	Chesterfield to Norwood	-	11	6 8	45	0	0	0
	Norwood to Workfop	-	8	1 5	0	0	85	0
	Workfop to River Trent at Stockwith	-	21	6 5	0	0	250	0
Chester Canal.	Chester to Barbridge	-	14	5 9	170	10	0	0
	Barbridge to Middlewich	-	8	5 3	0	0	40	0
	Ditto to Nantwich	-	3	3 0	626	0	0	0
Langley Bridge Canal.	Langley Bridge to River Trent	-	11	5 4	0	0	108	8
Leeds Canal.	Low Water at Liverpool to Fouridge	-	66	0 0	525	0	0	0
	Fouridge to the River Air at Leeds	-	42	0 0	0	0	446	0
Caldon Canal and Railway to Lime Works.	Trent and Mersey Canal to Stanly Mofs	-	6	6 2	75	0	0	0
	Stanly Mofs to Froghall	-	9	4 9	0	0	60	10
	Railway from Froghall to Caldon Lime Works	-	3	1 7	L.			
Sankey Canal.	Low Water in the River Mersey to St. Helen's	-	12	0 0	90	0	0	0
Huddersfield Canal to Cooper's Bridge.	Huddersfield to Cooper's Bridge	-	8	0 0	0	0	56	10
Liverpool Canal to Kendal, Westmorland.	Liverpool to Kendal	-	72	0 0	86	6	0	0
N. B. 54½ Miles Level.								
Basingstoke Canal to Weybridge.	Basingstoke to Weybridge	-	44	0 0				
Andover Canal to Redbridge.	Andover to Redbridge	-	22	4 0	0	0	176	9
Winston Canal, in Durham, to Stockton on Tees.	Winston to Stockton	-	27	0 0	0	0	328	0
Cardiff to Merthyr Tidwell Canal.	Cardiff to Merthyr Tidwell, Glamorgan-shire	-	25	0 0				
Swansey Canal to Furno Vaughan.	Swansey to Furno Vaughan, ditto	-	13	0 0				
Kidwelly Canal to Mr. Keymer's Coal Mines.	Kidwelly to Keymer's Coal Mines, Carmarthenshire	-	3	2 0				
	From Grangemouth, Lock No. 1. to Lock No. 20.	-	10½	2 0	156	0	0	0
Forth and Clyde Canal, Scotland.	From Lock No. 20. to Lock No. 21.	-	16	0 0	L.			
	From Lock No. 21. to Lock 39.	-	8	6 0	0	0	156	0
	Collateral Cut to Glasgow	-	2	6 0				

N. B. The Letter L denotes the Canal to be level.

Difference of Prices of Carriage of Goods by Canal and Land.

	By Canal.	By Land.
	Per Ton.	Per Ton.
	£. s. d.	£. s. d.
Between Gainsborough and Birmingham	1 10 0	0 0 0
Manchester and Etruria, the Centre of the Potteries	0 15 0	2 15 0
Ditto and Bromley Common, three Miles to Litchfield	1 0 0	4 0 0
Land-carriage from thence to Litchfield	0 0 0	0 2 6
Ditto and Shardlow, six Miles from Derby	1 10 0	3 0 0
Land-carriage from Shardlow to Derby	0 0 0	0 5 0
Ditto and ditto, twenty Miles from Leicester	1 10 0	6 0 0
Land-carriage ditto to ditto, twenty Miles	0 0 0	0 16 8
Ditto and Nottingham	2 0 0	4 0 0
Ditto and Newark	2 0 0	5 6 8
Ditto and Wolverhampton	1 5 0	4 13 4
Ditto and Birmingham	1 10 0	4 0 0
Ditto and Stourport	1 10 0	4 13 4
N. B. Packs of Wool and Pockets of Hops being very bulky Articles	2 0 0	0 0 0
Liverpool and Etruria	0 13 4	2 10 0
Ditto and Bromley Common	1 0 0	0 0 0
Ditto and Shardlow	1 10 0	0 0 0
Ditto and Nottingham and Newark	2 0 0	0 0 0
Ditto and Wolverhampton	1 5 0	5 0 0
Ditto and Birmingham	1 10 0	5 0 0
Ditto and Stourport	1 10 0	5 0 0
Chester and Wolverhampton	1 15 0	3 10 0
Ditto and Birmingham	2 0 0	3 10 0
Ditto and Stourport	2 0 0	3 10 0
The Freight between Gainsborough and Shardlow (being the Junction of the Canal with the Trent), and between Bristol and Stourport (being the Junction of the Canal with the Severn), will be about, per Ton.	0 10 0	0 0 0
N. B. The above Prices are only for perishable Goods; those not perishable will be carried at a lower Price.		
Forth and Clyde, the whole Distance from Sea to Sea, or Two-pence per Mile per Ton	0 5 10	0 0 0

F I N I S.

Difference of Prices of Goods by Canal and

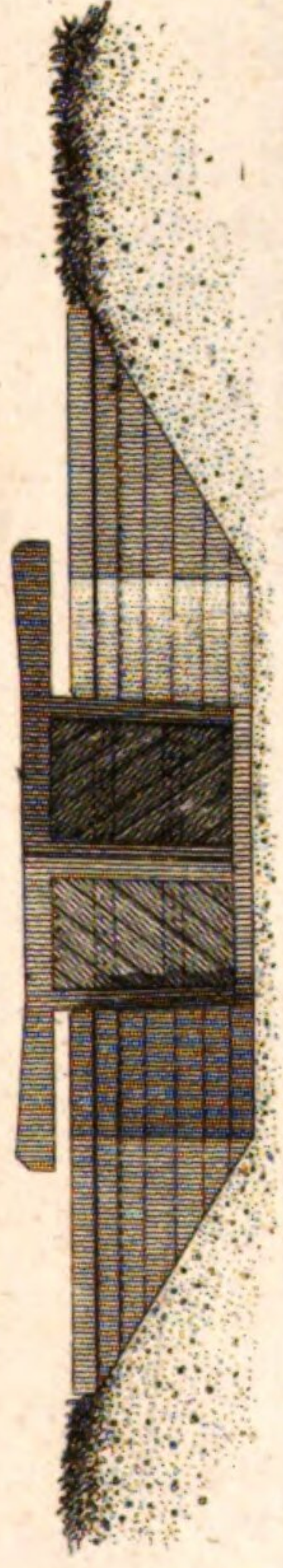
Land

No.	Date	Place	Description	Price	Quantity	Total
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						
65						
66						
67						
68						
69						
70						
71						
72						
73						
74						
75						
76						
77						
78						
79						
80						
81						
82						
83						
84						
85						
86						
87						
88						
89						
90						
91						
92						
93						
94						
95						
96						
97						
98						
99						
100						

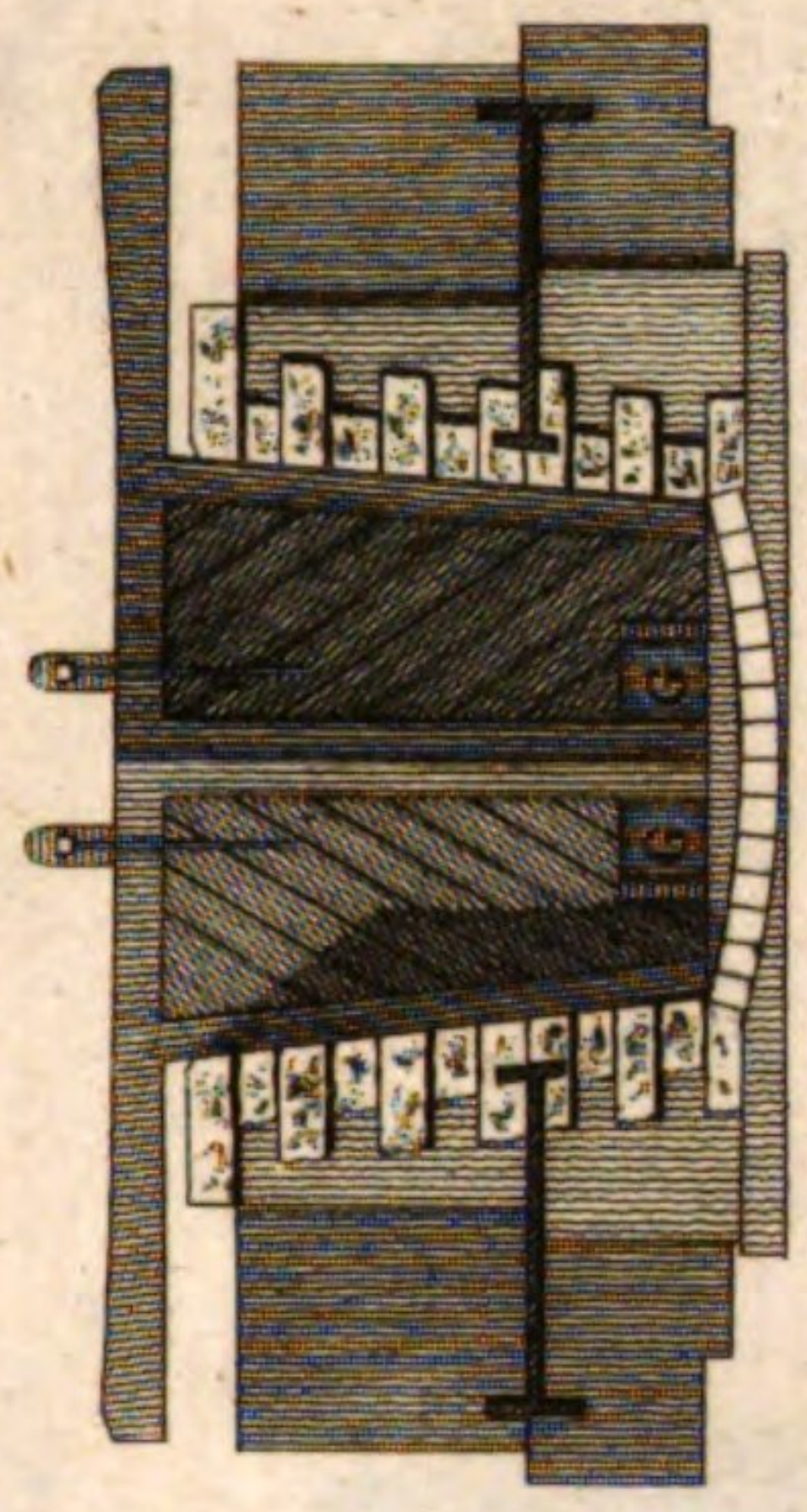
F I N I S

Lock for a Canal.

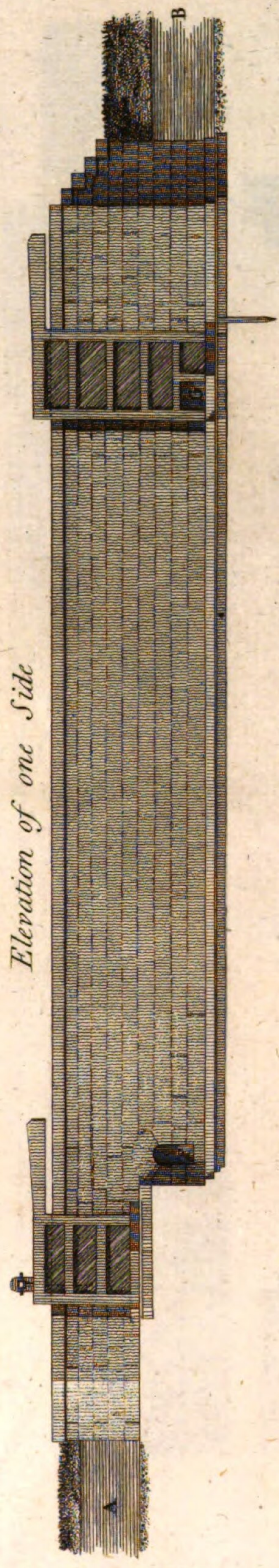
Upper Gates



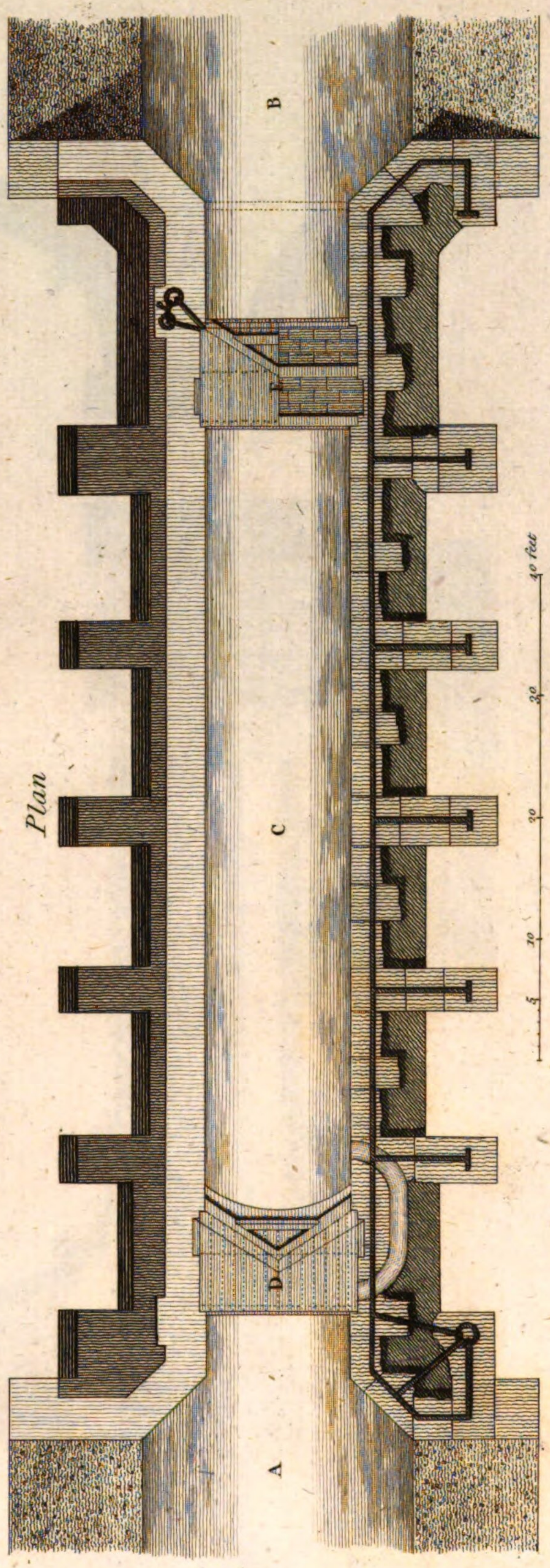
Lower Gates



Elevation of one Side

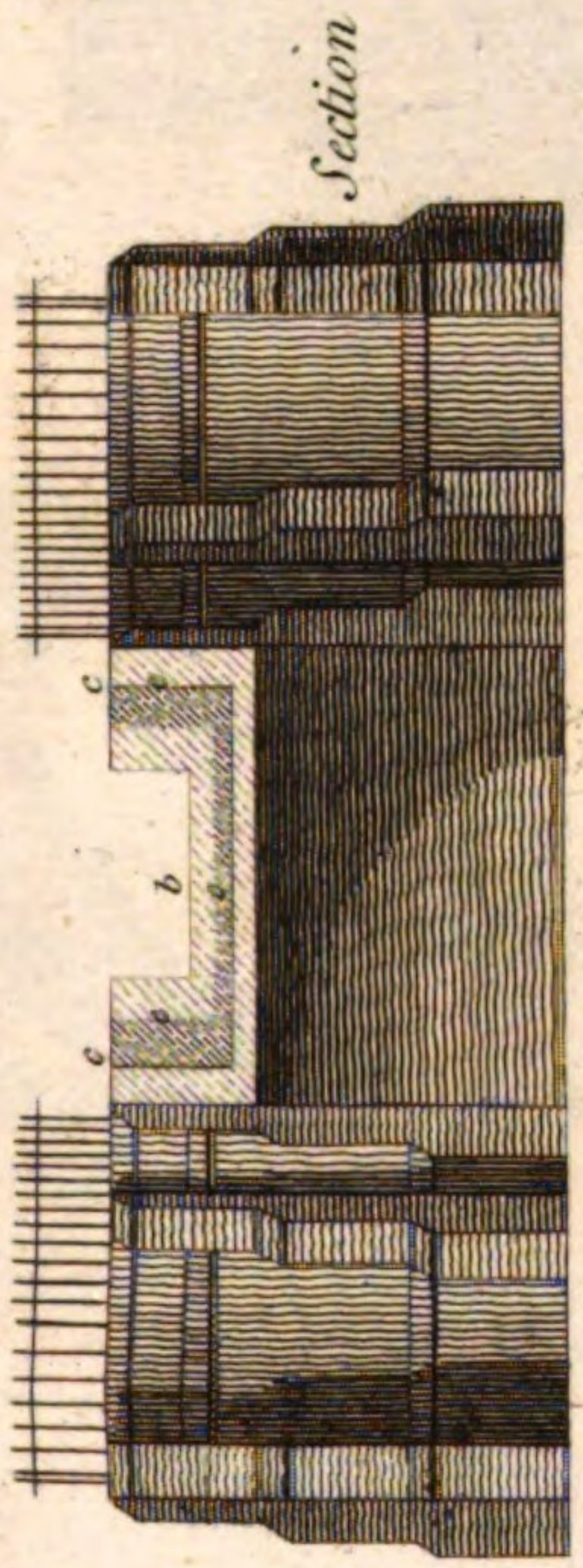


Plan

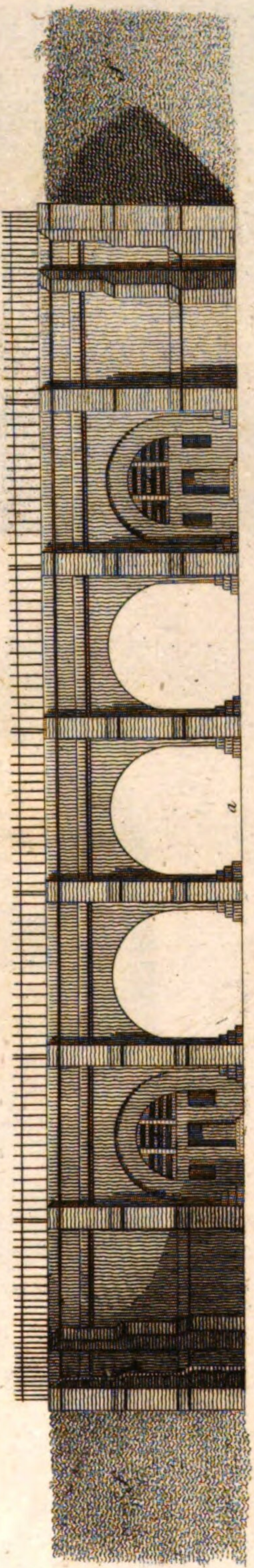


40 feet
30
20
10
5

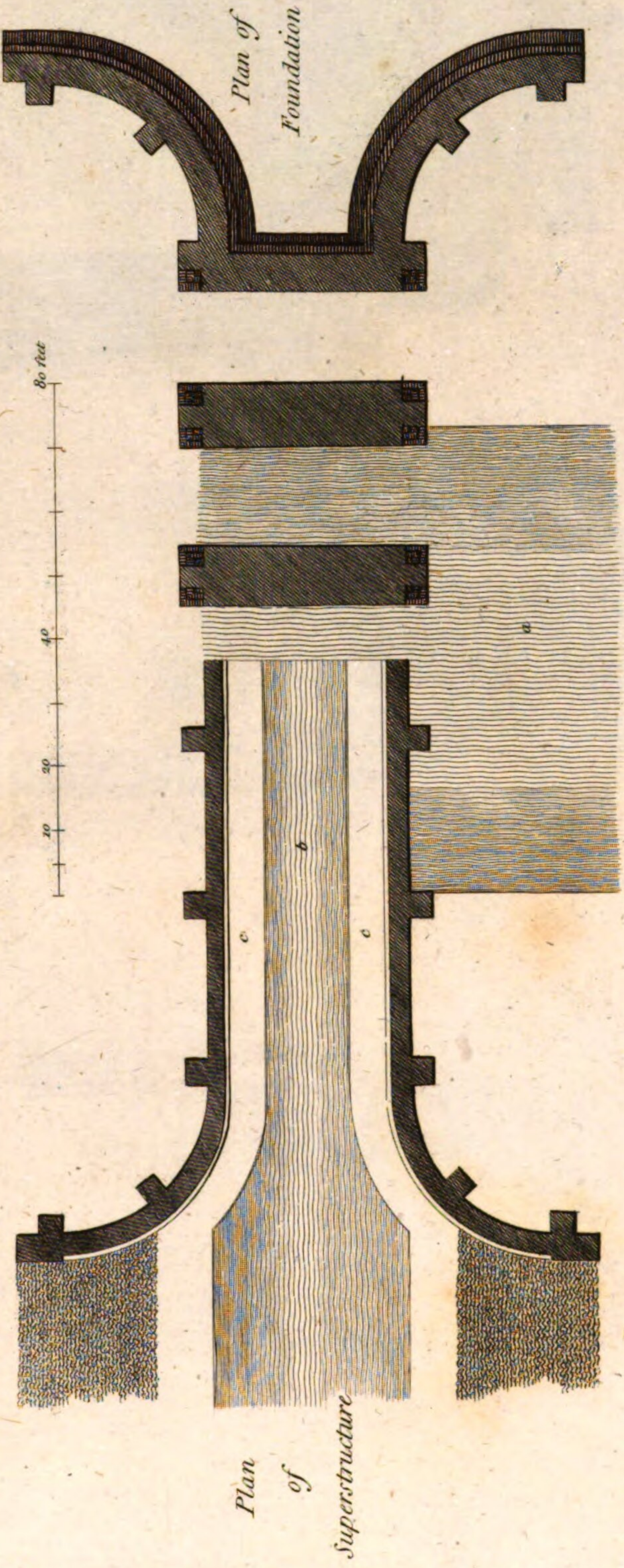
Aqueduct for a Canal.



Section



Elevation



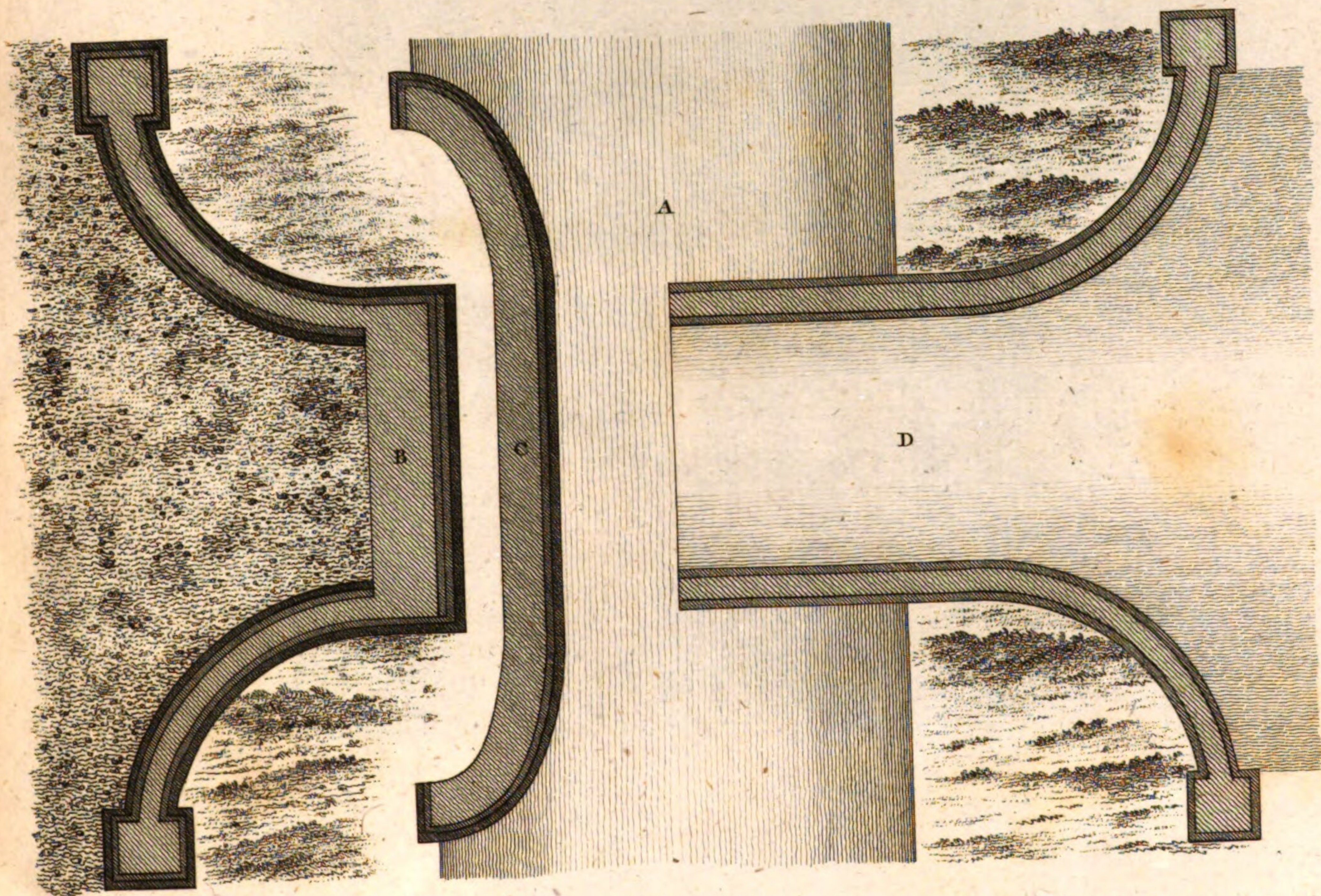
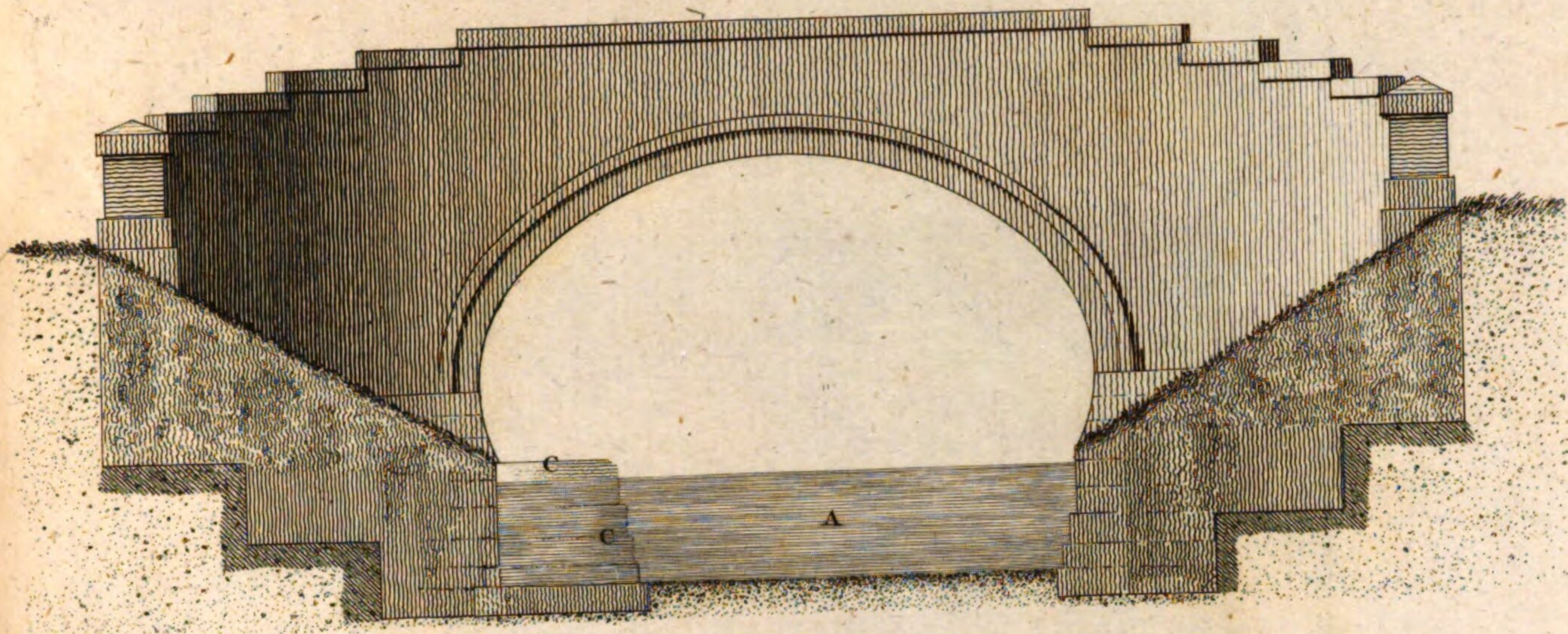
*Plan of
Superstructure*

*Plan of
Foundation*

Handwritten text, possibly a signature or date, at the top center.



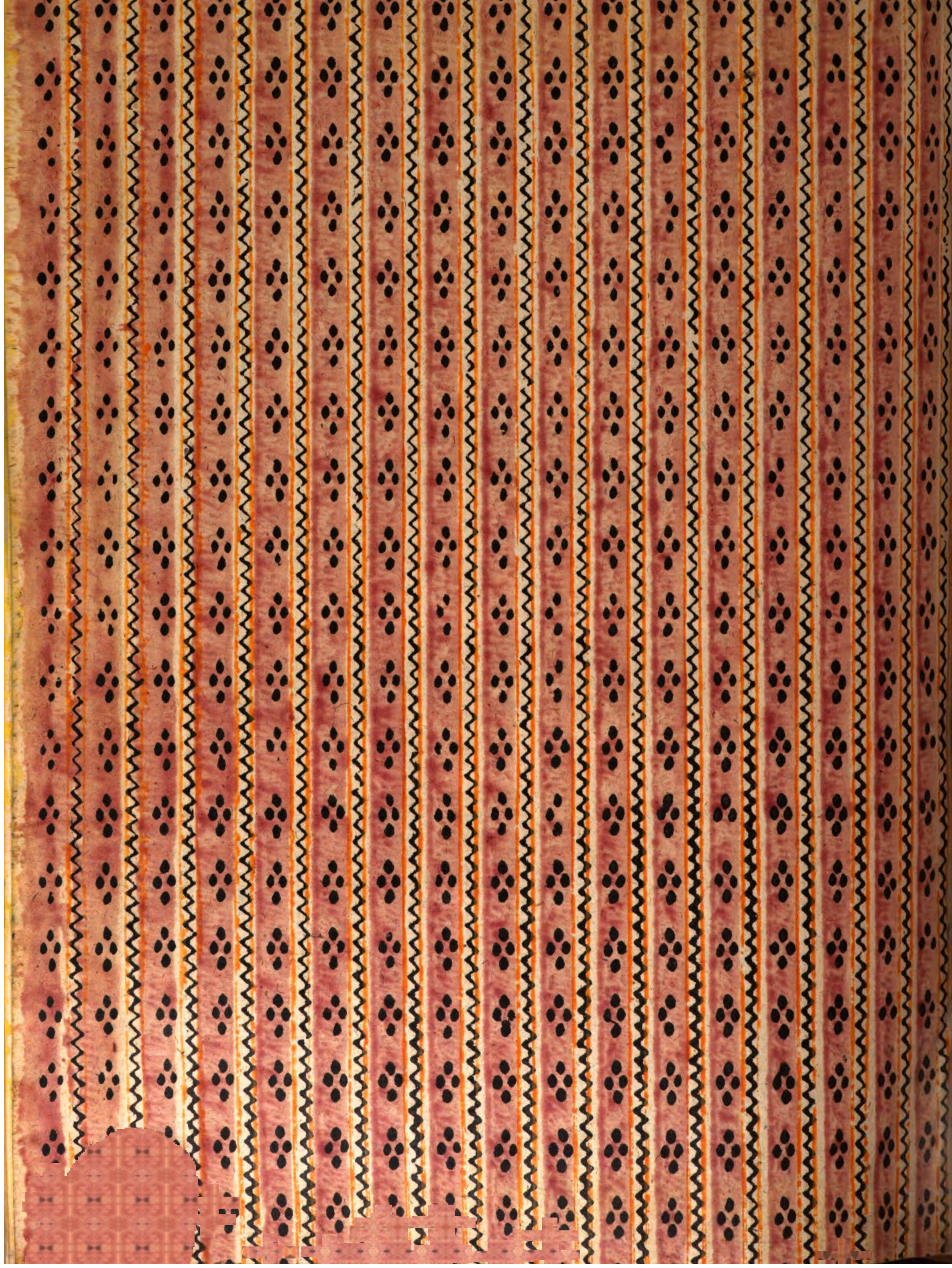
Bridge for a Canal.

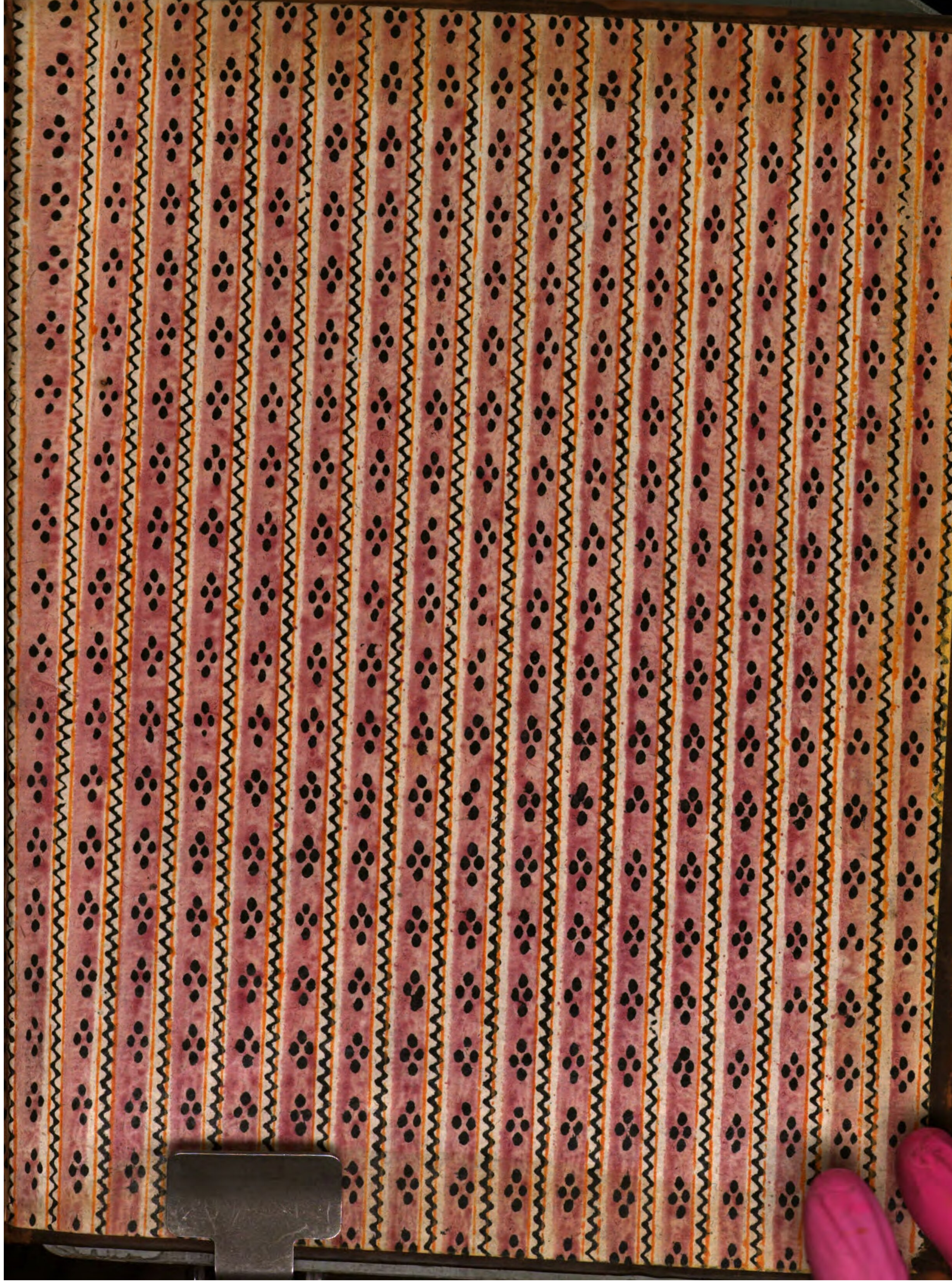




Accommodation Bridge for a Canal.

London, Printed for Jas. J. Taylor, N° 68, Holborn.







Phillips, John

A general history of inland navigation, foreign and domestic with a map of
all the canals in England, and other useful plates

London 1792

4 Brit. 89

urn:nbn:de:bvb:12-bsb10225356-7